

18/G
BULLETIN No. 36



DECEMBER, 1932

The Maine Agricultural Experiment Station

Summary Report of Progress 1932



High yield of potatoes per acre is an important factor in economical production

FINANCIAL STATEMENT
For the Fiscal Year Ending
June 30, 1932

UNIVERSITY OF MAINE
THE MAINE AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE

MAINE
AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE

THE STATION COUNCIL

PRESIDENT HAROLD S. BOARDMAN,	President
DIRECTOR FRED GRIFFEE,	Secretary
FRANK P. WASHBURN, Augusta,	Committee of
THOMAS E. HOUGHTON, Fort Fairfield,	Board of Trustees
HARMON G. ALLEN, Sanford,	
FRANK P. WASHBURN, Augusta,	Commissioner of Agriculture
FRANK A. POTTER, Bangor,	State Grange
WILSON H. CONANT, Bucksport,	State Pomological Society
JOHN W. LELAND, Dover-Foxcroft,	State Dairymen's Association
EDGAR B. LORD, West Lebanon,	Maine Livestock Breeders' Ass'n.
WILLIAM G. HUNTON, Portland,	Maine Seed Improvement Ass'n.
CHARLES C. CLEMENTS, Winterport,	Maine Poultry Improvement Ass'n.

And the Heads and Associates of Station Departments, the Director of the Extension Service, and the Dean of the College of Agriculture

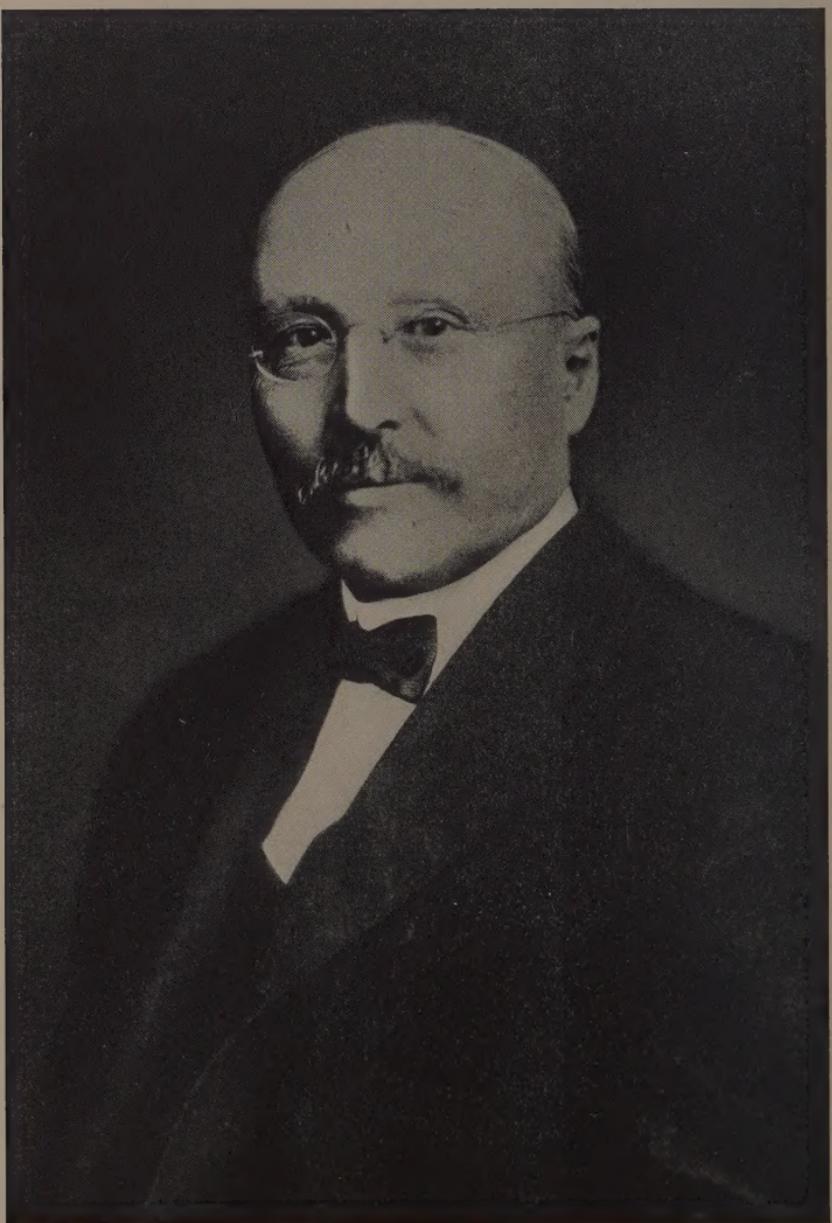
THE STATION STAFF

Administration	Fred Griffey, Ph.D., Director Charles C. Inman, Administrative Assistant Mary N. Cameron, Secretary Rose H. McGuigan, Stenographer Lillian M. Marquis, Stenographer Irville H. Cheney, B.S., Superintendent of Highmoor Farm Silas O. Hanson, Superintendent of Aroostook Farm
Agricultural Economics	Charles H. Merchant, Ph.D., Head of Department George F. Dow, M.S., Associate Economist William E. Schrumpf, M.S., Assistant Economist Merton S. Parsons, M.S., Assistant Economist Elaine M. Pooler, Chief Assistant Magretta Blackmore, Assistant Dorrice E. Smith, Assistant
Biology	W. Franklin Dove, Ph.D., Head of Department John W. Gowen, Ph.D., Collaborating Biologist, Animal Breeding Joseph A. Chacka, Ph.D., Associate, Plant Breeding and Nutrition Russell M. Bailey, B.S., Associate, Plant Breeding and Nutrition Frederick B. Chandler, B.S., Assistant, Blueberry Investigations Irvin C. Mason, B.S., Assistant, Blueberry Investigations Delmar B. Lovejoy, B.S., Assistant, Plant Breeding and Nutrition Elizabeth F. Murphy, B.A., Assistant, Animal Breeding and Nutrition Iva M. Burgess, M.S., Assistant Mildred R. Covell, Assistant Emmeline W. Kenney, Laboratory Assistant Bell Dall, Clerk
Chemistry	James M. Bartlett, Sc.D., Head of Department, Inspection Analyses Elmer R. Tobey, M.S., Ch.E., Research Chemist C. Harry White, Ph.C., Associate, Inspection Analyses Bernie E. Plummer, M.S., Assistant, Inspection Analyses George P. Steinbauer, Ph.D., Seed Analyst
Entomology	Edith M. Patch, Ph.D., Head of Department Clarence R. Phipps, Ph.D., Entomologist John H. Hawkins, M.S., Assistant Geddes W. Simpson, A.M., Assistant Alice W. Averill, Laboratory Assistant
Home Economics	Pearl S. Greene, M.A., Head of Department Marion D. Sweetman, Ph.D., Associate Lolie Smith, M.S., Associate *Merna M. Monroe, M.S., Assistant
Plant Pathology	Donald Folsom, Ph.D., Head of Department Reiner Bonde, M.S., Associate Florence L. Markin, M.S., Assistant Gladys E. Babbin, Laboratory Assistant and Assistant in Seed Analysis

*Temporary appointment.

CONTENTS

	PAGE
Introduction	233
Departmental reports on projects :	
Agricultural economics.....	233
Animal breeding and nutrition.....	247
Plant breeding and nutrition.....	250
Blueberry investigations.....	262
Chemistry	264
Entomology	266
Home economics	271
Plant pathology.....	274
Announcements :	
New buildings	294
Council and staff changes.....	296
Lists of projects for 1932-1933.....	297
Publications issued in 1932.....	300
Abstracts :	
Dispersal of the apple maggot.....	300
Spraying and dusting experiments for the control of potato aphids.....	301
The apple maggot.....	301
The relation of maturity, size, period in storage, and variety to the speed and evenness of cooking of potatoes	302
Estimated yield losses from late blight in Aroostook County for 1930 and 1931.....	303
A promising blight resistant potato.....	303
Potato virus diseases in 1931.....	304
Meteorological observations.....	304
Report of the Treasurer.....	307



WHITMAN HOWARD JORDAN

WHITMAN HOWARD JORDAN

It seems eminently fitting that the Maine Agricultural Experiment Station should make a permanent record of the passing of a man whose activities were so vitally connected with its early history and who was largely responsible for the success the Station attained during the first ten years of its existence. Doctor Whitman Howard Jordan was born and raised on a rugged Maine farm in the town of Raymond. His life upon the farm gave him a practical and valuable experience admirably suited for the life work he eventually chose to follow. He lived and grew to manhood in much the same manner as most country boys of his time, working hard in the fields in summer and walking long distances, often through deep snow, to attend school a few months in the winter. His chief amusements in that sparsely settled region were trapping, hunting, and fishing. The fur obtained from the first mentioned recreation furnished him with some very welcome spending money. His love for these sports and the great out-of-doors he retained through life, and the writer had the pleasure of making many very enjoyable trips with him throughout the many years of his acquaintance. In the matter of vacations our tastes were much alike. The only thing for us to do was to tramp through woods or brush with dog and gun, particularly during the woodcock migration season.

When the boyhood days were over and the country lad was ready for college he debated for some little time whether to go to Bowdoin or Maine. As a medical preparatory course was what he wanted the fact that Maine gave more chemistry and was less expensive decided the matter for him.

Following graduation from the Maine State College in 1875 he taught in the public schools for a time. He then took a course in chemistry and physics at Cornell University, giving particular attention to agricultural chemistry under Doctor Caldwell, whose influence, no doubt, had much to do with young Jordan's choice of agriculture as his life work.

He went to Wesleyan University from Cornell and worked for a few months under Doctor Atwater as Assistant Chemist. In 1879 he came to the Maine State College as Professor of Agricul-

ture where he remained one year. During this time he married Miss Emma Wilson of Orono, who survives him.

After spending a year at Orono he received a call from the Pennsylvania State College to take the position of Professor of Agriculture and Agricultural Chemistry which position he held until 1885. The Maine Legislature of 1885 passed an Act establishing the Maine Fertilizer Control and Agricultural Experiment Station. The Board of Managers appointed, many of them friends and acquaintances of Professor Jordan and familiar with his previous work in Maine and in Pennsylvania, naturally turned to him as the man best fitted to fill the position of Director. He consequently received the call, accepted the position, although at some financial sacrifice, and came to Orono July 1, 1885.

Doctor Jordan gave his time wholly to the Station work until Professor Balentine's death February 4th, 1894. Doctor Harris, who was then President, persuaded Director Jordan to take the position left vacant by Professor Balentine's death, which he did with some reluctance. He filled the dual position as Professor of Agriculture and Director of the Station for the remainder of his stay at the University.

In 1896 the office of Director in the New York State Experiment Station became vacant. This was one of the largest and strongest Stations in the country at that time; consequently the office was a very desirable one both financially and professionally. The Board of Control carefully looked up the men considered most capable of filling the position and asked a few of them to come to Geneva for an interview. Doctor Jordan was included in the number and a few weeks later he received a notice that he had been elected to the position. He accepted the position but it was with deep regret that he had to leave Maine. In all his busy years in this much larger field he never lost interest in the Maine Station, his first field of endeavor, or in the town of Orono as was evinced by his return to Orono to make his home after retirement in 1921.

It is not my purpose in this brief memorial to give any account of the great work Doctor Jordan did for the cause of agriculture. That has already been ably set forth by others in the various scientific and agricultural journals and is familiar to all students of scientific agriculture. It is my desire rather to bring to notice some incidents in his career not mentioned by others and possibly known only to his older acquaintances.

Doctor Jordan by nature was admirably equipped to do the life work of his choice. He was not only a scholar and scientist but a forceful and effective public speaker. Without doubt his success in this State and later in New York was due in no small measure to his ability to go before audiences of farmers and others and present a subject in plain and simple language, easily understood.

He was also a good mixer and was equally at home in gatherings of young or old. He never grew old in his mind and even in his years of failing health was as much interested in sports and games as in his younger days.

With the passing of Doctor Jordan, Agriculture lost a faithful friend.

James Monroe Bartlett

BULLETIN 363

INTRODUCTION

The progress of the investigational work of the Station during the past year has been very gratifying. Through some revisions and additions, the program has been made even more comprehensive than in past years and this in spite of some reduction in available funds as a result of lowered sales income from the farms. More emphasis is being placed on studies which have a bearing on the economy of production. Complete reports of the studies are given only after sufficient information has been obtained to warrant the drawing of rather definite conclusions. A brief report is given of the current year's progress.

AGRICULTURAL ECONOMICS

PRICES OF FARM PRODUCTS AND PRICE TRENDS IN MAINE.
Charles H. Merchant. The study of farm prices and price trends in Maine has been completed. This study includes price series of farm products and price indices for the more important agricultural products produced in Maine. Some of the price series extend over a period of 80 years by months. For each important agricultural product of the State an attempt has been made to show the causes for the major fluctuations in prices during the last 20 years as well as to give some indication of what may be expected during the next few years.

One section of the manuscript includes a brief discussion of the agricultural situation in Maine. In this section consideration has been given to wholesale and retail prices, farm wages, transportation rates, farm taxes, and real estate values. An attempt has been made to show the important price relationships, especially during periods of prosperity and depression.

As foundational material for the discussion of prices, considerable information on acreage and production of crops and on the number and value of livestock in Maine and the whole United States is included. Considerable attention is given to the purchasing power of the principal farm products in Maine. It is shown that the purchasing power of livestock, especially horses and cows,

moves in fairly regular cycles. In general these cycles conform very closely with those of the country as a whole.

FARM TAXATION IN MAINE. Charles H. Merchant and Merton S. Parsons. The study of farm taxation includes briefly (1) taxes paid by farmers and trends in taxes which have taken place during the last twenty years, (2) relation of farm taxes to farm capital and farm income, (3) assessment of farm property, (4) a brief consideration of the administration of the general property tax, and (5) suggested methods for improving our tax system.

The principal tax paid by farmers is the general property tax, which amounts to about 80 per cent of all farm taxes. Due to the outstanding significance of the general property tax, the study is devoted largely to a discussion of this tax.

Farm-property taxes have increased rapidly since 1916. Real estate taxes per acre in Maine increased from an index of 100 in 1913 to 255 in 1930. During this same period real estate values per acre were at an index of 121 in 1930 as compared with 100 in 1913. Taxes on all classes of livestock have increased materially in the last 20 years.

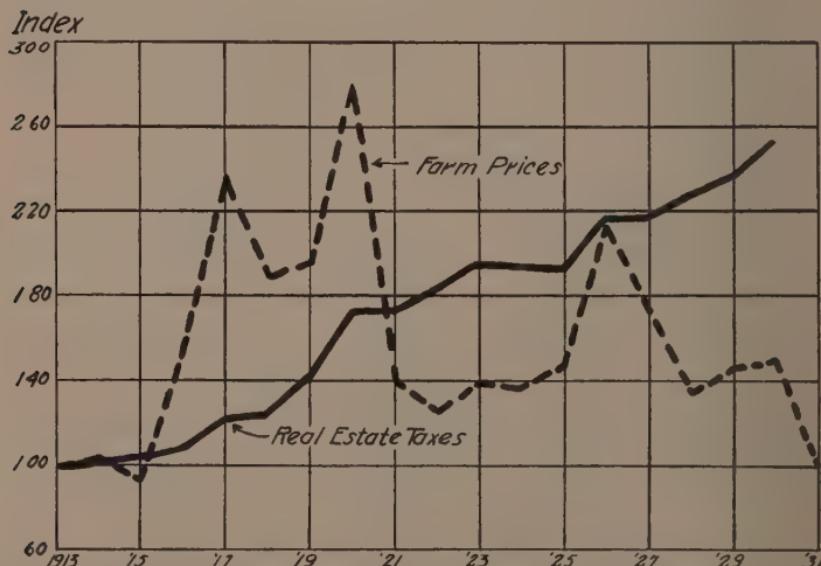


FIG. 23. Prices received by producers for farm products and farm real estate taxes per acre in Maine. Farm-property taxes require a relatively larger proportion of the farm income at the present time than before the World War.

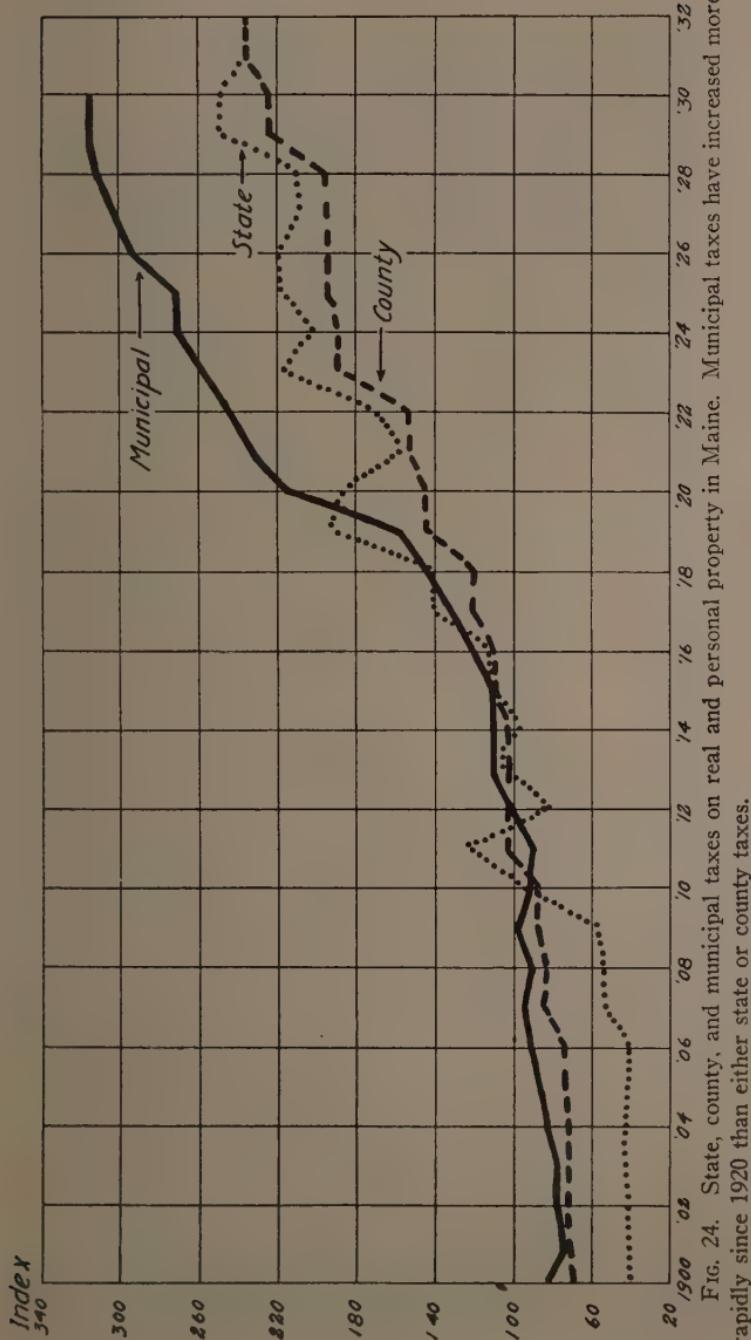


FIG. 24. State, county, and municipal taxes on real and personal property in Maine. Municipal taxes have increased more rapidly since 1920 than either state or county taxes.

Information on 422 farms in the State during 1924 to 1930 shows that farm-property taxes on the average absorbed 12.70 per cent of the farm income and the tax amounted to 1.55 per cent of the farmer's investment in real and personal property. On farms valued at less than \$5,000, farm-property taxes amounted to 2.22 per cent of the investment. The per cent which taxes were of the capital investment decreased as the size of the investment increased. Farmers with small incomes were taxed relatively more than those with large incomes.

Many inequalities in the assessment of farm property were found to exist. These discrepancies appeared between towns and even within individual towns.

An analysis of the information points clearly to several practical suggestions for improving the present farm-tax situation. Some of the more important suggestions which will be offered deal with (1) broadening the base of the tax system with special reference to a State income tax, (2) efficiency and economy in the administration of public funds, (3) improvement in assessment and levying of the property tax, and (4) efficiency and economy through the consolidation of local units into larger units of government.

THE PRODUCTION AND UTILIZATION OF MILK IN MAINE.
George F. Dow. Included in this study is a description of Maine dairy herds, presenting the size of herds, breeds of cows kept, and the amount of milk and cream sold per herd.

In 1928, about 31 per cent of the total milk produced in Maine* was sold by dairymen to the larger dairy dealers (those who purchased an equivalent of 500 or more quarts of milk daily). An additional 27 per cent was sold to the smaller retailers (those who purchased less than 500 quarts daily). The remaining 42 per cent of the total milk produced was consumed on the farm or sold as farm butter.

The data in Table 1 indicate that milk and cream sales in Aroostook and Washington Counties were relatively unimportant. Dairymen's sales of milk and cream to the smaller retailers were

* Total milk production was estimated by the Maine Department of Agriculture, Maine Crop and Livestock Review, 1928. Mimeographed report, p. 20.

relatively important in York, Knox, Sagadahoc, and Cumberland Counties. Sales to the larger dealers represented more than half the total milk produced in Franklin, Waldo, Somerset, and Androscoggin Counties.

TABLE 1

Farm Utilization of the Total Milk Produced in Maine During 1928 by Counties

County	Per cent of total production		
	Sold to larger dealers	Sold to smaller retailers	Farm use and farm butter
Androscoggin	51.45	37.07	11.48
Aroostook	1.14	9.07	89.79
Cumberland	36.31	41.40	22.29
Franklin	59.92	23.42	16.66
Hancock	26.08	39.06	34.91
Kennebec	34.56	32.45	32.99
Knox	19.07	52.86	28.07
Lincoln	33.00	16.98	50.02
Oxford	27.21	18.29	54.50
Penobscot	39.24	29.04	31.72
Piscataquis	23.33	19.43	57.24
Sagadahoc	14.47	48.07	37.46
Somerset	52.21	14.87	32.92
Waldo	58.43	7.13	34.44
Washington	2.71	22.79	74.50
York	11.36	56.05	32.59
Average for Maine	31.02	27.07	41.91

The approximate amount of both milk and cream sold by dairymen within each town to the larger dealers has also been computed. This indicates the relative importance of each town in Maine as a source of milk and cream supplies.

Nearly two-thirds of the total milk and cream sold to the larger dealers were delivered to plants that shipped the majority of their supply to out-of-State markets.

The greatest concentration of dairymen's sales to the larger dealers was in Cumberland, Waldo, Androscoggin, Franklin, Somerset, Penobscot, and Kennebec Counties, listed in order of importance. In each of these counties 235 pounds or more of butterfat was sold per 100 acres of farm land.

There was a distinct tendency to sell relatively more milk and less cream in the more concentrated areas, as is indicated in Table 2.

TABLE 2

The Relation of the Concentration of Butterfat Sales to the Proportion Sold as Milk and as Cream in 1928 by Towns

Pounds of butterfat sold per 100 acres of farm land	Number of towns	Per cent of butterfat in each group sold as	
		Milk	Cream
Under 125	96	37.96	62.04
125 — 249	69	42.04	57.96
250 — 374	36	55.88	44.12
375 and over	61	75.66	24.34
Total or average	262	60.70	39.30

The seasonal variation in dairymen's sales of both milk and cream was less in Maine than in Vermont or New York. The spread between the index numbers of milk sales (averaged for the high months of May and June and averaged for the low months of November and December) was only 35 points for Maine as compared with 42 points for Vermont and 67 points for New York. Similarly, cream sales in Maine during 1928 varied only 57 points as compared with 82 and 111 points in Vermont and New York respectively. Sales of milk and cream by Maine dairymen, therefore, more nearly approximate market demand.

The seasonal variation in dairymen's sales also has been computed for each type of dairy plant in the State.

The average butterfat test of all milk sold to the larger dealers was 4.14 per cent, and that of cream was 16.68 per cent.

Prices dairymen received for milk and cream were influenced by the type of dairy plant sold to and by the basis of payment. The basis of payment influenced the quality of milk and cream, especially the butterfat content of the product that dairymen delivered.

Although milk was the most important product purchased by the larger dealers in 1928, cream was the most important product sold from these plants. Of the total butterfat utilized, 58 per cent was sold as cream as compared with only 30 per cent as milk. The large quantity of cream sold was obtained by separating large amounts of whole milk at these plants. However, the amount of milk converted into cream has declined since 1928 with an increase in milk shipments from Maine to out-of-State markets.

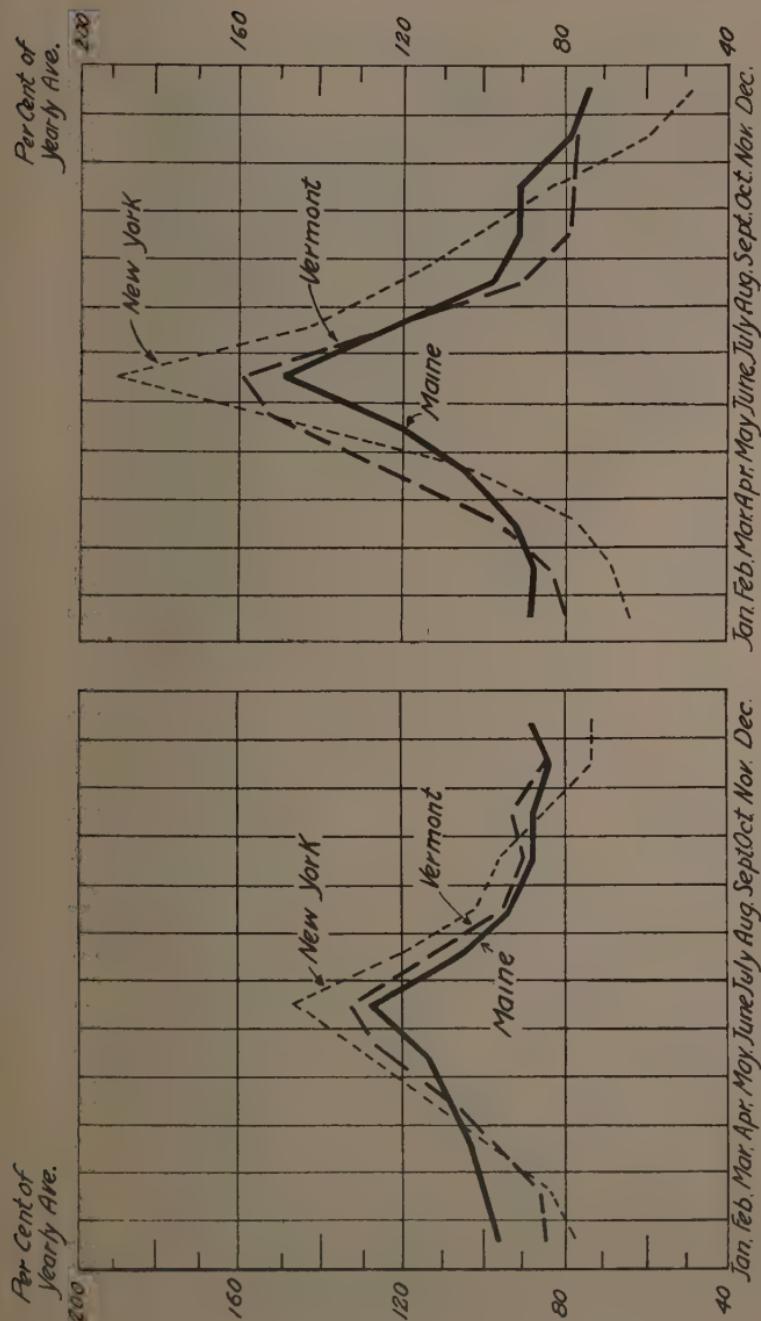


FIG. 25. The seasonal variation of all milk and cream sold by Maine dairymen to dealers in 1928 as compared with dairymen's sales in New York during 1928 and in Vermont during 1929.

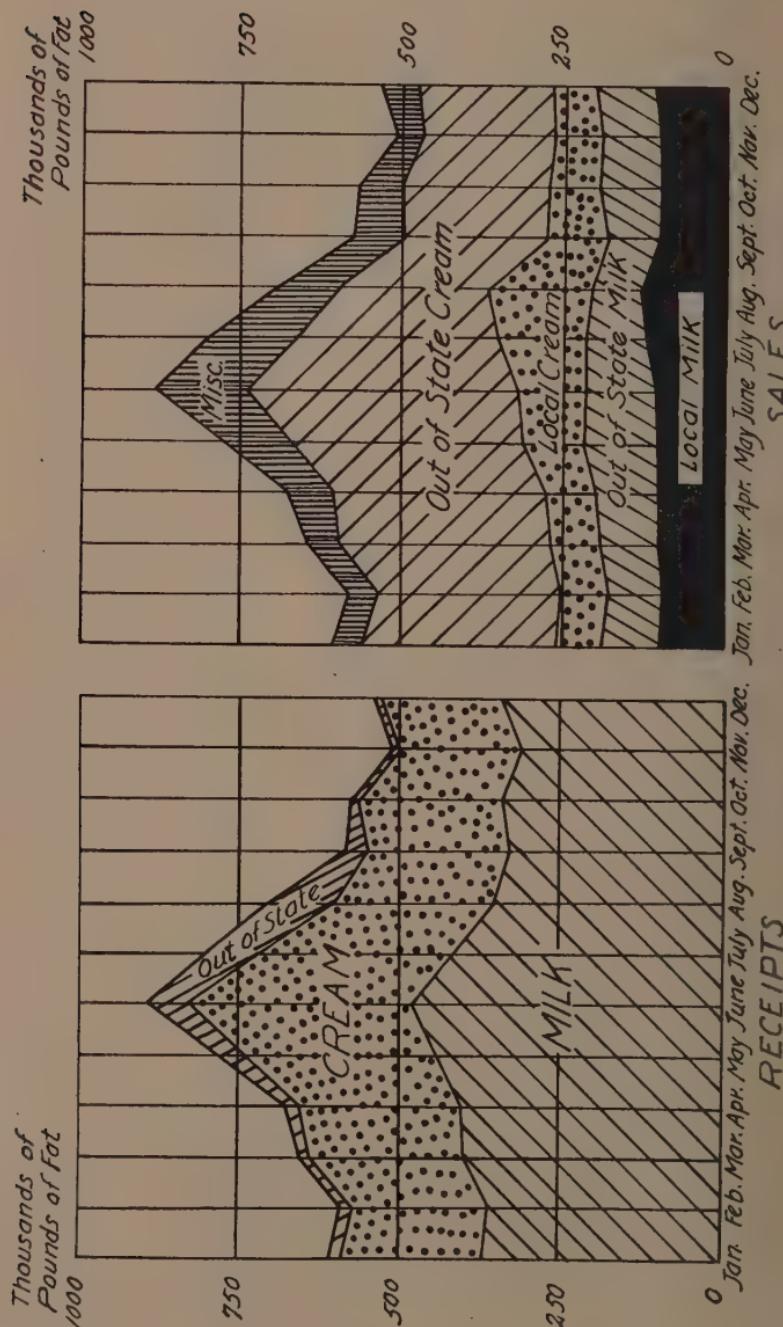


FIG. 26. Plant utilization of butterfat received by the larger dealers in Maine during 1928.

Of the total butterfat in 1928, about 30 per cent was sold locally, 58 per cent was shipped out of the State, and 12 per cent was used in manufactured dairy products. Milk sold locally by the larger dealers was approximately equal in amount to milk shipped out of the State. The total butterfat in cream sold locally was about equal to that in the local sales of milk. Cream shipped out of the State was by far the most important dairy product and included most of the seasonal surplus in May, June, and July.

The remaining 12 per cent of the butterfat represented dairy products used in the manufacture of ice cream, cheese, butter, and condensed milk. The seasonal variation in the manufacture of each of these dairy products and of skimmilk utilized has been determined.

AN ECONOMIC STUDY OF THE COST OF COLLECTING MILK AND CREAM IN MAINE. George F. Dow. The data for "An Economic Study of the Cost of Collecting Milk and Cream in Maine" have been secured. Detailed information for 91 collection routes was obtained during the summer of 1932. These data include for each route the number of dairymen, the distance covered per trip, kind of roads, average volume hauled per trip, time required in hauling, equipment used, opportunities for reducing the rate charged for collection, a record of collection costs including man and horse labor, and itemized costs for the use of auto trucks. From this information the variations in costs and other information are being determined and the relationships analyzed. For example, the effect of the kind and condition of roads on collection costs was important. This was especially true on some unimproved dirt roads during the spring of the year. Other relationships being studied in connection with costs include the distance travelled per 100 pounds of milk collected, the volume hauled per trip, and the number of dairymen per route. The itemized costs for the use of trucks are also to be studied to determine methods by which collectors may be able to collect more efficiently.

AN ECONOMIC STUDY OF THE POTATO INDUSTRY IN MAINE. William E. Schrumpf and Charles H. Merchant. The production phase of this study was begun in 1929 to determine: (1) the status and trend of the Maine potato industry in regard to size of the potato enterprise, production methods, labor requirements, machinery requirement (especially tractors and trucks), the costs and returns

on potatoes, and farm and labor incomes; and (2) the effect of the various factors of farm organization on farmers' incomes.

Information covering the entire farm business, and especially the production and disposal of the potato crop, has been obtained from producers in three important potato areas in the State. The three areas are: (1) that about Caribou, Fort Fairfield, and Presque Isle in Aroostook County, (2) that in the neighborhood of Houlton, also in Aroostook County, and (3) that in the vicinity of Corinna and Dover-Foxcroft in central Maine. For the two areas in Aroostook County, information from each producer who co-operated in the study was obtained for the three years ending March 31, 1928, 1929, and 1930. For the central Maine area, similar information was obtained for the two years ending March 31, 1929 and 1930.

Financial summaries of the farm businesses for each producer have been computed and averaged. These summaries include: (1) average capital in real estate, livestock, machinery, and feeds and supplies; (2) farm receipts from crops sold, increase in capital, livestock and livestock products sold, and miscellaneous sources; (3) farm expenses for labor, fertilizer, taxes, and all other farm expenditures; (4) farm income, obtained by subtracting farm expenses from farm receipts; and (5) labor income, computed by subtracting interest on average farm capital from farm income.

Farm business analyses have been computed and averaged. The business analysis considers labor income, size of farm, farm balance, production rates, use of labor, and distribution of capital.

The trends in the use of horses as compared with tractors and trucks as farm tractive power have been worked out, showing a decrease in the number of horses and an increase in the number of tractors and trucks. The increase in the number of dual purpose tractors is especially noticeable.

A preliminary analysis of two groups of farms of similar size in central Maine, for the years ending March 31, 1929 and 1930 has been made. One group of farmers had an average labor income of minus \$171 compared with a labor income of \$2,271 for the other group. Each group averaged 21 acres of potatoes. The difference in labor income between the two groups appeared to be related chiefly to use of hired man labor and yield per acre of potatoes.

Man labor cost more and was less efficient on the low income farms. Yield per acre of potatoes averaged 81 barrels for the low income group compared with 111 barrels for that of high income. The difference in yield appeared to be related to organic content of the soil, number of harrowings, quality of seed, and amount of spray material applied per acre of potatoes.

Similar analyses of low and high income groups of farms in the Houlton, and the Caribou- Fort Fairfield- Presque Isle sections are being made.

FACTORS AFFECTING THE QUALITY OF MAINE POTATOES. William E. Schrumpf. This study was conducted in cooperation with the Maine Development Commission and the Maine Department of Agriculture: The objects of the study are: (1) to determine the extent and causes of mechanical injuries to potatoes incurred by (a) digging, (b) picking into baskets, (c) emptying into barrels, (d) storing, (e) development in storage, (f) moving to graders, and (g) grading; and (2) to show the relationships between the various handling practices and mechanical injuries.

During the 1931 and 1932 potato harvests in Aroostook County, in the vicinity of Caribou, Fort Fairfield, and Presque Isle, potatoes were examined in the field to determine the extent of the injuries caused by these various operations, as well as the relationship between the bruised and cut potatoes and various types of diggers, number and size of stones in field, amount of weediness, and several other factors.

Injuries to potatoes are designated as major and minor cuts and major and minor bruises. Major injury is sufficient to change the grade of potatoes from U. S. No. 1 to culls. Minor injury, although affecting the appearance and perhaps the keeping quality of potatoes, does not change the grade.

Potato injury due to cuts averaged for the two years 0.9 per cent, of which 0.4 per cent was major and 0.5 per cent was minor. Engine diggers caused nearly 1.5 times and traction diggers about 2.3 times as much cutting of potatoes as power-take-off diggers.

Total bruising of potatoes caused by digging averaged 17.7 per cent, of which 1.8 per cent was major and 15.9 per cent was minor. The injury from shaker elevator diggers averaged more than twice as much as from the continuous elevator machines. Padding on the shaker elevator diggers reduced bruising materially.

The number of stones in the potato fields was related to amount of bruising. The amount of bruising with 500 stones or more passing over the digger with 100 pounds of potatoes was more than 2.5 times as great as with 149 stones or less.



FIG. 27. Potato digging scene in Aroostook County. The two-row, power-take-off digging equipment with continuous elevator bruises few potatoes when carefully handled. The equipment shown above would cause less bruising if the deflectors at the rear of the digger were padded or taken off.

Bruising from picking into baskets averaged 2.1 per cent, of which 0.3 per cent was major and 1.8 per cent was minor.

Emptying potatoes from baskets into barrels caused an average of 8.1 per cent bruising, with 1.9 per cent major and 6.2 per cent minor.

In both farm and track storage houses samples were taken and the amount of bruised potatoes ascertained. These samples were placed in storage and examined again at a later date in order to detect any bruising not evident at the time of storing. Injury to potatoes incurred by storing and increases in major defects in storage have been determined for 1931 and are nearly completed for 1932 and for the average of the two years.

POTATOES BRUISED BY DIGGING
 and
 Percent NUMBER of STONES

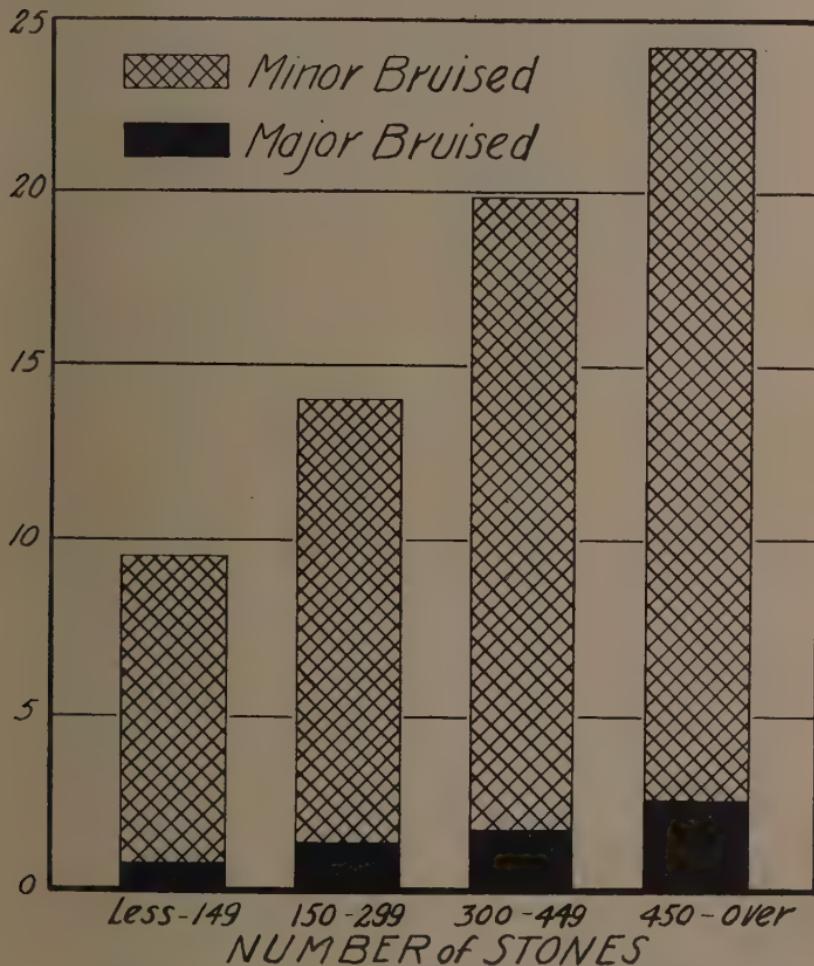


FIG. 28. Careful picking of field stones is an essential step in the prevention of bruising during digging.

Potato houses at rail sidings were visited while potatoes were being graded with mechanical graders. At these houses samples were obtained just before grading to note the bruising caused by

moving to the graders. Then samples from the same lots of potatoes were taken just after grading to determine the injury incurred during this operation.

LOCAL MARKET CONDITIONS AND REQUIREMENTS OF AGRICULTURAL PRODUCTS IN MAINE (EXCEPT AROOSTOOK COUNTY). Charles H. Merchant and Merton S. Parsons. This project is a study of local market conditions and requirements in various sections of the State in an attempt to assist farmers in adjusting their agricultural production to more nearly meet these conditions and requirements where feasible. This study involved (1) securing information from stores, hotels, restaurants, and camps as to their purchases of agricultural products which are either now grown or can be profitably produced in the region and (2) securing information as to the practicability of farmers supplying local market requirements. The second part of this study is closely associated with land utilization.

York County was the first area selected for study. The agriculture of this County has been declining for a number of years. This change has taken place in an area where there are several industrial centers and where there is a large amount of summer tourist trade. The field work for this study in York County began July 1, 1932. It included the collection of detailed information on the purchases of agricultural products by stores, hotels, and restaurants in the larger towns and cities of the County. Information was obtained from 106 stores, hotels, and restaurants. In securing this information an attempt was made to secure a representative sample of retail establishments selling agricultural commodities.

For the second part of the study detailed information was secured from 206 farmers as to their farm businesses during the year ending April 1, 1932. This information was obtained on a number of different types of farms in several areas of the County. The data were supplemented by material from town assessors' reports, topographical maps, and a general survey of size and condition of farm buildings in several of the towns of the County. The information collected for this study is now being tabulated and analyzed.

ANIMAL BREEDING AND NUTRITION

STUDIES ON GROWTH AND THE ANTI-RACHITIC VITAMIN.

W. Franklin Dove. (A) *The Vitamin D and Protein Value of the Maine Sardine and White Fish.* A few years ago it was observed in this laboratory that the by-products of the Maine sardine canning industry were highly anti-rachitic as tested on growing chicks. During the past year a large portion of the work under this project has been devoted to the biological assaying of the sardine as well as other fish and fish by-products from the Maine coast.

Under controlled laboratory conditions, it has been found that the dried sardine meal, either from whole fish or as refuse from the canning process, is still anti-rachitic to the extent that when fed as the only animal protein supplement it practically suffices for all vitamin D requirements of the growing chick.

Attention is now being turned to the determination of the causes for variation so that a uniform product can be secured which will in all cases meet the vitamin D requirements. The method of processing is perhaps the principal determining factor in this respect. To date, all meals testing high in vitamin D were produced by the vacuum process and secured from Mr. T. H. Letson of the Maine Fish Meal Company, Portland, Maine.

Tests are now being made of sardine meals produced by other methods, especially by fire drying. Fire drying usually heats the material to excessively high temperatures so that both the vitamin D and the proteins are injured. However, this may not prove to be true for all the methods of fire drying now being tested.

It is also apparent that the sardine as well as the white fish meal is an excellent source of proteins. The usual high degree of digestibility of fish products appears to be retained in these meals, at least when made by the vacuum process.

As an animal food, high in the minerals calcium and phosphorus, containing valuable proteins and vitamins essential to growth and reproduction, these Maine coastal products should find a more important place in the rations of farm animals.

A peculiar situation exists in the State with a highly capitalized coastal fishing industry experiencing difficulty in the marketing of its products, and within the same State a demand for these products and by-products as animal food which is met by purchases from outside the State.

In the past these by-products were made for and used as a soil fertilizer—principally as a nitrogen and phosphorus carrier. Now that these fertilizer elements may be readily secured from inorganic sources the demand as a fertilizer may never return. But there seems to be no reason to prevent the shifting of this valuable product into food channels.



FIG. 29. View of battery room in the new Experiment Station poultry plant, showing all-metal batteries and ventilating flues. These "Turkey" size batteries may be used as experimental mating pens, ensuring sufficient head room for large cockerels.

Slight changes must be made in the method of processing in order to secure a product that contains no spoiled or rancid material, and a product that has not been injured by heat. With regard to these factors as well as to the attempt to produce a uniform product in other respects one company is now closely approaching that standard. When prepared for use in the manufacture of fertilizer, these meals can not be recommended as an animal food.

(B) *Red Light and the Prevention of Cannibalism.* By diffusing the battery room with red light, cannibalism in chicks has been entirely eliminated (p. 177, An. Rpt. 1931). Experiments have been continued in order to determine the effect of red lights on the physiology of the bird. Birds have been subjected to experimental rations in rooms diffused with different colored light—red, blue, and white. Under these conditions red light does not prevent the action of anti-rachitic substances.



FIG. 30. Nutrition experiments are made on chicks kept under controlled conditions. The wire-floored, all-metal batteries may be disassembled for washing and sterilization, reducing disease to a minimum. The chicks are allowed the freedom necessary for normal growth and development.

PHYSIOLOGY OF REPRODUCTION. W. Franklin Dove. (A) *Embryonic Death.* This study is a continuation of the analysis of records taken on all eggs failing to hatch (p. 174, An. Rpt. 1931). The data include weight, age at death, sex, teratological defects, and position, and have been taken as a standardized laboratory procedure on individually pedigreed eggs.

These records now cover six years' work in an attempt to build up a standard expectancy table in that phase of the physiology of reproduction which is usually missing, e.g., the nature of lethal factors. With these records we hope to be able to estimate cause from effect and to build up a standard for predicting the effects of inbreeding and nutrition on embryonic death.

(B) *Determination of Sex.* The method of distinguishing sex in chicks (p. 175, An. Rpt. 1931) has been applied to other birds, as guineas, turkeys, ducks, and geese. Both genetic and physiological methods of sex distinction are being tested.

PLANT BREEDING AND NUTRITION

POTATO FERTILIZER EXPERIMENTS. Joseph A. Chucka and Delmar B. Lovejoy. The potato fertilizer work on the permanent plots has now been in progress for six years. That means that each plot has received two fertilizer treatments on the three-year rotation, three treatments on the two-year rotation and six treatments on the continuous cropping. The results of 1932 from the permanent plots are in general quite similar to those obtained in the past. The outstanding differences in the fertilizer ratio study were obtained with the 4-0-7, 4-8-10, and 4-8-14 treatments. The 4-0-7 treatment gave an appreciably lower yield in 1932 than it did in the past. Treatments 4-8-10 and 4-8-14 gave lower yields this year than the standard 4-8-7. In the rate of application study increased yields were again obtained with increased amounts of 4-8-7 fertilizer up to and including the 3,000 pound application. With present potato prices, however, the 2,000 pound application was more profitable than either the 2,500 or 3,000 pound application. In the study of sources of nitrogen, the use of ammonium sulfate resulted in a higher yield than the use of nitrate of soda when these materials were used as single sources of nitrogen. This is contrary to the results obtained during the past few years. However, a mixture

containing equal quantities of nitrogen from ammonium sulfate and nitrate of soda again outyielded all of the treatments containing a single source of nitrogen. The two limed plots outyielded the corresponding unlimed plots by 7.6 and 9.6 barrels per acre respectively.

In addition to the work on the permanent plots, potato fertilizer tests were conducted on twelve privately owned farms distributed throughout Aroostook County. The study of the effect of magnesium in potato fertilizers was continued on five different farms during the past season. Fertilizer mixtures containing 10, 20, 30, and 60 pounds of magnesium oxide from each of four sources were compared with our standard 4-8-7 fertilizer mixture without additional magnesium. The five farms used for this test were selected so as to represent as wide a range in soil fertility as possible. The range in soil fertility is indicated by the yields obtained with our standard 4-8-7 treatment. These yields were 76.8, 89.8, 112.1, 146.8, and 175.9 barrels per acre, respectively, on the five farms. The results of the test suggest the following conclusions: first, that the response to magnesium varies inversely with the fertility of a soil. The response to magnesium was very definite on the first three farms, doubtful on the fourth and negative on the fifth. Second, that there is probably no justification for using more than 20 to 30 pounds of magnesium oxide per acre in potato fertilizers. And third, that the more soluble salts of magnesium like Epsom salts and double sulfate of potash-magnesia are more desirable than dolomitic limestone as a source of magnesium for potato fertilizers.

During the past season seven different sources of phosphorus, namely, superphosphate, ammoniated superphosphate, basic slag, dicalcium phosphate, tricalcium phosphate, rock phosphate, and colloidal phosphate were compared in a 4-8-7 mixture on two farms. Superphosphate gave the best yield of potatoes.

A comparison of 4-8-7, 4-8-10, and 4-8-14 formulas was made on two farms. On both farms the formula with seven per cent potash gave the highest yield and the formula with fourteen per cent gave the lowest yield.

The use of either ground or whole tobacco stems as a partial or sole source of potash again gave fairly good results.

On the two farms where 4-8-7 and 5-8-7 formulas were compared the formula with the four per cent nitrogen gave the higher yield in both cases.

Small amounts of limestone varying from 50 to 400 pounds per ton were used as a filler in potato fertilizers on seven different farms. The results obtained indicate that limestone in potato fertilizers low in magnesium tends to reduce potato yields. When limestone is used in fertilizers which contain sufficient magnesium it seems to have little if any effect on potato yields.

UNCOMMON ELEMENT TEST ON POTATOES. Joseph A. Chucka and Delmar B. Lovejoy in cooperation with Bailey E. Brown of the United States Bureau of Chemistry and Soils. A study was made of the effect of small amounts of magnesium, manganese, copper, nickel, and zinc in potato fertilizers on two farms in Aroostook County. The results obtained from this study indicate that magnésium and manganese in small amounts tend to increase potato yields while nickel, copper, and zinc tend to lower potato yields.

FERTILIZER PLACEMENT STUDY WITH POTATOES. Joseph A. Chucka and Delmar B. Lovejoy in cooperation with Bailey E. Brown of the United States Bureau of Chemistry and Soils, and with G. A. Cummings of the United States Bureau of Agricultural Engineering. In this study 4-8-7 and 8-16-14 fertilizers were placed in seven different positions with respect to the seed piece. The results obtained indicate that the placement of fertilizer is an important factor in determining the potato yields with a given fertilizer treatment. During the past season best results were obtained when the fertilizer was placed in two bands about two inches away from and at the same level or somewhat below the seed piece.

GREEN MANURING CROPS FOR POTATOES. Joseph A. Chucka and Delmar B. Lovejoy. The past season's results again indicate the need of organic matter in potato soils. Additional organic matter increases potato yields and improves their type. Thus far no crops have been found better than medium red and mammoth red clovers for green manuring crops in the ordinary three- and four-year rotations. In two-year rotations crimson clover, crimson-mammoth mixture, peas and oats-peas-vetch mixture make excellent green manuring crops in Aroostook County. For best results crimson clover and crimson-mammoth mixture should be plowed

late in September or during the first part of October. The past season's results indicate that crimson clover in Aroostook County makes only about half of its growth by the first of September. If it is necessary to plow before potato digging either peas alone or a mixture of oats-peas-vetch make a better green manuring crop to grow because these make most of their growth by the middle of August.



FIG. 31. Plots at Aroostook Farm, Presque Isle, Maine, where crops are tested for their use as sources of organic matter.

GRAIN VARIETIES AT AROOSTOOK FARM. Joseph A. Chucka and Delmar B. Lovejoy. *Oats.* Four varieties of oats, Maine 340, Gopher, Cornellian, and Worthy were grown in the grain variety test at Aroostook Farm. The yields obtained ranged from 41.5 to 51.4 bushels per acre. Worthy oats gave the highest yield, Maine 340 second, Gopher third, and Cornellian fourth. Although Worthy oats gave a slightly higher yield than Maine 340 it is not particularly suited for Aroostook conditions because it is late in maturing and very susceptible to lodging. Gopher oats is earlier than Maine

340 and because of its short stiff straw it does not lodge. During the three previous years it outyielded Maine 340 and therefore appears to be a very promising variety of oats for Aroostook County.

Barley. Four varieties of barley, Alpha, Wisconsin #6, Wisconsin #38, and Velvet, were grown in the variety test. Alpha, which is a two-row rough bearded barley is by far the best yielding barley of all the varieties tried. Wisconsin #6 is a six-row rough bearded barley and a relatively poor yielder under Aroostook conditions. Wisconsin #38 and Velvet are both six-row smooth awn barleys. Of these two Wisconsin #38 gave the larger yield during the past season.

Spring Wheat. Garnet, Red Fife, and Marquis were the three varieties of spring wheat grown in the variety test during the past season. Of these Garnet is by far the best yielding wheat.

Winter Wheat. Minturki and Minhardi were the two winter wheats grown in the variety test. Of these Minturki was the better yielder. Its yield was nearly twice as large as that of Garnet, the best spring wheat. The winter wheats were sown about the middle of September after Irish Cobbler potatoes were dug. Winter killing occurred in only one spot in the field.

Winter Rye. Only one variety of winter rye was grown in the grain variety test. It seemed to do very well under Aroostook conditions and yielded 38.6 bushels per acre. No winter killing was observed.

Flax. Bison and Red Wing flax were grown in the variety test for the first time. Both varieties seemed to do very well under Aroostook conditions. Bison yielded 14.8 bushels and Red Wing yielded 12.5 bushels per acre.

CANNING PEAS. Two varieties of canning peas, Surprise and Perfection, were planted at five different dates at Aroostook Farm during the past season. The largest yield of shelled peas was obtained with both varieties from the planting made on June 1. At this planting Surprise yielded 3.783 pounds and Perfection 5.682 pounds of shelled peas per acre. The dry weight of vines from this same planting amounted to 3,023 pounds per acre for Surprise and 3,590 pounds per acre for Perfection. These results indicate the possibility of using canning peas as a combination cash crop and green manuring crop in Aroostook County.

FERTILIZERS FOR SWEET CORN AND BEANS. Joseph A. Chucka, Delmar B. Lovejoy, and Russell M. Bailey. Fertilizer and lime experiments with sweet corn and beans have been in progress for two years at Highmoor Farm. These experiments are designed to furnish information on the kind, amount, and method of application of fertilizer and on the amount of lime to be used



FIG. 32. An excellent growth of Chang field peas on organic matter plots.

for best results with sweet corn and beans. With respect to kind of fertilizer for sweet corn all that can be said at this time is that sweet corn at Highmoor Farm shows greatest response to phosphorus, second greatest response to nitrogen, and least response to potash.

When a 5-15-5 fertilizer was used in the row increased yields were obtained up to and including 600 pounds of fertilizer per acre. In 1931 when cut corn was valued at two and one-half cents per

pound the 600 pound application of fertilizer proved to be most profitable. However, in 1932 when cut corn sold for only one and one-half cents per pound the 200 pound application of fertilizer was most profitable. The increased yield resulting from higher applications did not pay for the extra cost of the fertilizer.

Broadcast applications of 500, 1,000, and 1,500 pounds of fertilizer per acre all gave some increase in sweet corn yields. However, the increases obtained were not large enough to pay for the cost of the fertilizer at 1932 prices. The same was true for combinations of row and broadcast applications.

Lime applications of 1,000, 2,000, and 4,000 pounds per acre all gave sufficiently large increased yields of sweet corn to pay for the cost of the lime. The 1,000 pound application showed the greatest return for money invested under price conditions of 1932. The results also indicate that lime applied a year before sweet corn is planted is far more effective in increasing yields than lime applied the same year the corn is planted.

Beans showed the greatest response to phosphorus and the smallest response to nitrogen fertilizer. With regard to the rate of application the results obtained indicate that applications greater than 500 or 600 pounds per acre were not profitable at Highmoor Farm under 1932 price conditions.

BREEDING NEW VARIETIES OF APPLES. Russell M. Bailey and Iva M. Burgess. During 1932, efforts to produce new varieties of apples better adapted to the soil, climatic, and market conditions of Maine orchards were continued. The need for a high quality late winter apple suited to Maine is being given particular stress. Crosses between promising varieties are made each year and as many seedlings grown as facilities permit. Several hundred seedlings resulting from crosses made in 1931 were grown at Highmoor Farm and the most promising of these will be moved to the seedling orchard to grow to bearing age. Seedling fruits, representing approximately 100 trees from the Spy x McIntosh cross, have been obtained and are under observation for various fruit characters, including keeping quality, flavor, texture, size, and attractiveness. Although the majority of these are decidedly inferior, the variability within the cross and the character of some of the better seedlings indicate this cross to be of considerable value in the breeding work.

APPLE POLLINATION STUDIES. Russell M. Bailey and Iva M. Burgess. Pollination studies involving the important Maine varieties have been conducted now over a three-year period. The results obtained each year are in close agreement and indicate that varieties which have been employed may be divided into two groups: (1) those varieties, including Rhode Island Greening, Baldwin, Stark, Rolfe, and Gravenstein, which produce a high percentage of abortive pollen grains; and (2) those varieties, including McIntosh, Cortland, Wealthy, Spy, Delicious, and Golden Delicious, which produced a high percentage of plump, functional pollen grains. Of the above mentioned varieties used as pollen sources, only those in group 2 have given satisfactory sets of fruit in hand-pollinated crosses. Relative germination of the various apple variety pollens on artificial media agrees closely with their relative efficiency obtained in hand pollination. Previous cytological investigations at the Maine Station have pointed out that the varieties of group 2 exhibit normal diploid chromosome behavior, whereas those of group 1 are irregular in their behavior. Hand self-pollinations of the varieties of both groups have resulted in a nearly complete failure to set fruit, thus emphasizing the importance of interplanting suitable varieties to insure efficient cross pollination.

BUD SELECTION IN THE APPLE. Russell M. Bailey and Iva M. Burgess. Studies of color variation in the McIntosh are offering some rather interesting information. Observation of the fruit of several orchardists indicates that two fairly distinct types of McIntosh coloring are prevalent, i.e., "striped blush" and "solid blush." Certain trees at Highmoor, which originated from a McIntosh tree producing highly colored fruit, have, during the two years in which they have borne fruit, produced attractive, "solid blush" apples whereas certain other trees, under similar conditions, and which originated from a McIntosh producing poorly colored fruit have grown "striped blush" fruit. If this evidence is further substantiated, it is plain that some care should be exercised in the selection of propagating wood.

SMALL FRUITS. Russell M. Bailey and Iva M. Burgess. The work with small fruits at Highmoor Farm has made considerable progress during the past year. A fairly large number of varieties of grapes, raspberries, and strawberries were set in 1932.

Of seven varieties of strawberries tested in 1932, Howard Supreme and Howard 17 were outstanding in quality and yield. The former variety produced medium sized, high quality, dark red fleshed berries which were particularly attractive for preserving. Its keeping quality is equal, if not superior, to that of the well-known Howard 17 or Premier, but it produces imperfect flowers and must be interplanted with a variety producing perfect flowers. It did not appear the equal of Howard 17 in fruit yield or in plant productivity.

CANNING CROPS. Russell M. Bailey and Iva M. Burgess. Variety and strain tests of the more important canning crops in Maine, with particular emphasis on corn and beans, were continued in 1932.

Sweet Corn. A comparative test of sweet corn strains and hybrids was conducted at Highmoor Farm in connection with the breeding work. One hundred seventy-one plots were devoted to the trial of thirty-three double cross hybrids, five cannery strains of Golden Bantam, four Crosby strains, and two other varieties.

Of the garden varieties the following have responded well: Golden Gem, Spanish Gold, Harris Extra Early Golden Bantam, and Golden Sunshine. The order of maturity, beginning with the earliest, is in the sequence given.

The cannery strains of Golden Bantam were later maturing than the above varieties and were of superior quality. Distinct differences in the time of maturity and in ear characters, particularly number of rows, were noted between them.

The sweet corn "double cross" hybrids obtained by the crossing of selected inbred lines responded well in comparison to commercial varieties and cannery strains of Golden Bantam. The hybrids were earlier maturing and exhibited greater uniformity, and their yield was greater. One hybrid yielded at the rate of approximately 5,400 pounds of cut corn per acre whereas the highest yielding cannery strain of Golden Bantam yielded approximately 4,400 pounds. Although the hybrids thus far are of a preliminary nature and were grown in the effort to study the breeding material, their superiority in yield, time of maturity, and uniformity, suggests the practical results to be obtained from such a breeding program.

Field Beans. The best strains from the 1931 plots and some additional ones of Red Kidney, Old Fashioned Yellow Eye, and pea beans were grown.

A. Red Kidney. From this season's observation, Geneva, an introduction from the New York Geneva Experiment Station, was the most promising strain. This was attacked less severely by diseases than most strains and, unlike others, was noticeable for the good seed color and type.



FIG. 33. Considerable attention is given to beans, both green and dry,
at Highmoor Farm

B. Old Fashioned Yellow Eye. Only the runner type strains and the two bush type strains found to be somewhat resistant to anthracnose were grown. The yield and seed type were the best in the Chapman strain and two Highmoor Farm selections. All of the runner type strains were relatively free from bacterial blight. Although there was only a small amount of anthracnose in the plots in 1932, these strains may become quite severely infected in other seasons. The two anthracnose resistant strains were severely infected with blight. Crosses have been made using these two types in the hope of obtaining strains which may combine the resistance to both diseases.

C. Pea Beans. Robust has proven satisfactory but California Small White was found to be not adapted to our climatic conditions.

The bean crosses previously made were planted in a field with diseased seed to insure infection. The plants which were apparently healthy have been selected and the most promising of these will be tested further by greenhouse inoculations.

String Beans. Varieties showing the most promise were Brittle or Round Pod Wax and New Stringless Green Pod, also known as Tendergreen. Another variety, Conserva, grown only in this past season, made a good canned product. The yield was less than for New Stringless Green Pod as the pods were smaller. The seed was white. One season's data are not sufficient to warrant the recommendation of a variety but this may prove worthy of more extensive trial.

GARDEN CROPS. Russell M. Bailey and Iva M. Burgess. The vegetable variety testing was continued during the past season at Highmoor Farm. In spite of the dry weather in late spring and early summer which caused delayed and uneven germination most of the crops grew well. From the results of several years' study the following varieties have been found dependable.

Beans. Snap beans: Green pod—Bountiful, Lowe's Champion, Giant Stringless Green Pod, Burpee Stringless Green Pod, Tendergreen (New Stringless Green Pod). Wax pod—Surecrop, Brittle Wax, Pencil Pod, Golden Age, and Jubilee.

Shell beans: French's Horticultural.

Lima beans: Jackson Wonder (not the best quality but the surest cropper).

Pole beans: Scotia, because of resistance to diseases, was the most dependable.

Cole crops. Broccoli—Green Sprouting Calabrese.

Cabbage—Early: Golden Acre, Copenhagen Market. Late: Danish Ball Head.

Cauliflower—Super Snowball.

Chinese Cabbage—Chihli.

Kohl Rabi—An excellent substitute for early turnips. Early Purple Vienna, Early White Vienna.

Greens and salad crops. Endive—Green Curled, Broad Leaved Batavian.

Kale—Bloomsdale Double Extra Curled.

Lettuce—Non heading: Beefsteak or Prize

Head (excellent for home garden only), Grand Rapids. Crisp heading: New York Special. Butter heading: White Boston "Unrivalled," All Heart (a strain of Salamander).

Mustard—Mustard Spinach or Tendergreen, Chinese White Mustard.

Spinach—Nobel Giant, King of Denmark, Long Standing Bloomsdale, Princess Juliana.

Swiss Chard—Fordhook Giant, Lucullus.

Cucurbits. Cucumber—Pickling: National Pickling, Chicago Pickling, Slicing: Green Pack, Early Fortune, Davis Perfect, Longfellow (a later variety which shows some resistance to scab).

Muskmelon—Oval fruits: Thousand Dollar, York County Special. Round fruits: Golden Champion, Golden Champlain.

Pumpkin—Small Sugar (New England Pie), Golden Oblong, Orange Winter Luxury.

Squash—Summer: Yellow Straight Neck. Small thin skinned baking type: Delicata. Early: Golden Delicious, Buttercup. Winter: Blue Hubbard, Hubbard, Golden Hubbard.

Root Crops. Beet—Crosby Egyptian, Early Wonder.

Carrot—Early: Coreless, General all season: Pride of Denmark, Hutchinson, Chantenay.

Parsnip—Model.



FIG. 34. The garden at Highmoor Farm includes tests of many different crops

Tomatoes. Early: Canadian, Cortland. Main crop: Bonny Best, John Baer, Early Esther. Of the varieties Break O'Day, Marglobe, and Pritchard (Scarlet Topper), which were recently introduced to the trade by the United States Department of Agriculture, Marglobe, although late, has made the most favorable impression.

From the selections made for freedom from growth cracks and for good fruit shape, two from Red River have been considered enough superior to the parent variety to be worth while. These selections, although not particularly good for fruit shape, have been remarkably free from cracking.

BLUEBERRY INVESTIGATIONS

FERTILIZERS. Frederick B. Chandler, Joseph A. Chucka, and Irvin C. Mason. The fertilizer plots begun in 1928 have been continued while those started in 1929 are still under observation but further applications of fertilizer have not been made. One-third of the plots receiving lime in 1931 were treated again in 1932. Several of these plots received as high as six tons of lime per acre in 1931 and six tons in 1932. This application has given no detrimental effects to the plants and at present no great differences are apparent in the condition or the kind of weeds present. A preliminary experiment in the greenhouse in the spring of 1932 indicated that the blueberry soils of Washington County need more organic matter.

SELECTION AND VARIETY TESTING. Frederick B. Chandler and Irvin C. Mason. The Whitesbog variety of blueberry passed the 1932 season in better condition than the preceding year but it does not seem to be exceptionally well adapted to Maine conditions. Eight new native varieties of *Vaccinium corymbosum* and twelve varieties of *Vaccinium pensylvanicum* and *Vaccinium canadense* were selected to be planted in our test plots.

POLLINATION AND STERILITY. Frederick B. Chandler, Irvin C. Mason, and Clarence R. Phipps. Harding proved to be self-sterile while Cabot and two of our native selections proved to be very self-fruitful. In a study of variety crosses a good set was obtained in all but one case and this was where Harding pollen had

been used. The species crosses between *pennsylvanicum* and *corymbosum*, and between *brittonii* and *pennsylvanicum*, and between *brittonii* and *corymbosum* all proved to give a fair or good set.



FIG. 35. Blueberry blossom time in Washington County

PROPAGATION. Frederick B. Chandler and Irvin C. Mason. The results of propagation studies indicate that there is a great variation in the percentage of rooted cuttings obtained from the different species and varieties. *Vaccinium pennsylvanicum* gave the highest percentage of rooted cuttings from small, underground stems and the least from cuttings obtained above ground.

WEED CONTROL. Frederick B. Chandler and Irvin C. Mason. The sweet fern plots have continued to show successful control by cuttings made from the middle of July to the middle of August. Earlier or later cuttings gave an increase in the number of young stems.

The laurel plots have not been continued long enough to show any significant differences in the control of this weed but heavy applications of manganese sulfate gave a very poor color to the leaves

and some tip killing of the plants. The blueberries on these plots were not as healthy as those receiving no manganese sulfate but showed no serious injury.

CHEMISTRY

WORK OF INSPECTION. James M. Bartlett, C. Harry White, and Bernie E. Plummer. The time of this department for the year 1932 has been wholly devoted to analytical work. The Commissioner of Agriculture is the executive of the laws regulating the sale of foods and drugs, feeding stuffs, fertilizers, agricultural seeds, insecticides and fungicides. All samples for analysis are taken by him or his agents and the Statutes require that the analyses shall be made at the Maine Agricultural Experiment Station.

Food and Drug Inspection. Two hundred and twenty-nine samples of foods and drugs were taken and analyzed. The results are reported in Official Inspections 143, a bulletin of 16 pages. Also, one hundred and ninety-two samples of canned foods were examined for the State Purchasing Department. The results of these examinations were not published but were reported to the Department. Two hundred and ninety-two samples of canned blueberries were examined for trash and maggots under the supervision of this department. The results were reported to the Commissioner of Agriculture and were not published by the Station.

Milk and Cream Inspection. Twelve hundred samples of milk and cream were analyzed for the Division of Dairy Inspection and the results reported to the Chief of that Division and not published by the Station.

Glassware for Testing Milk and Cream. Under the State law all creameries, ice cream manufacturers, or other parties buying or selling milk or cream on a basis of the butterfat content are required to have all Babcock milk and cream bottles and all pipettes, used for butterfat determinations, tested for accuracy by the Experiment Station. In 1932, six hundred and twelve pieces of glassware were received and tested. No inaccurate pieces were found.

Feeding Stuffs Inspection. One thousand and fifty-three samples of feeds were collected and analyzed. The results of the analyses are published in Official Inspections 144, a bulletin of 48 pages.

Fertilizer Inspection. Four hundred and thirty samples of fertilizer materials were collected and analyzed. The kinds of materials and the results of the analyses are given, in detail, in Official Inspections 145, a bulletin of 32 pages.

Agricultural Seeds, Insecticides and Fungicides. Two hundred and nineteen official samples of seeds were collected and tested.

In addition to the above official samples 14 samples of various kinds of seeds sent in by farmers and dealers have been tested, making a total of 233 samples tested during 1932.

Ninety-four samples of insecticides and fungicides were collected and examined.

The results of the examination are given in Official Inspections 146.

Gasolines and Motor Oils. The legislature of 1929 enacted a law requiring that automobile gasoline and oil be inspected. The state auditor was made the executive of the law, but the adoption of the Code Bill by the legislature of 1931 transferred this office to the state tax assessor. The act requires that the analyses shall be made at the Maine Agricultural Experiment Station and the expense of the same shall be taken from the fund created by the gasoline tax. The executive or his agents collect all samples.

Gasoline. Two hundred and thirty-seven samples of gasoline were collected and analyzed in 1932. There is very little difference in the composition of the different gasolines. Some makes are a little lighter than others and have a lower initial boiling point; consequently they start an engine more easily in cold weather than heavier grades. Only one sample was received that did not meet the standard required by the Statutes (that 96 per cent of a gasoline shall distill over below 437°F.). Several samples contained some dirt and water which was probably due to careless handling by the dealer.

Motor Oils. Although the motor oils have been very much improved and standardized there is still quite an amount of substitution being practiced. Out of the 482 samples collected and examined, 37 substitutions were found. In some cases the analysis indicated that the sample obtained was an entirely different oil from the one called for, as shown by the label. In most cases, however, the substitution appeared to be only a different grade from the one

called for. Several samples were found to contain dirt or sediment and several of them some water.

Nearly all the large companies now are making dewaxed oils which have a low pour point and are much better for winter use.

WORK OF INVESTIGATIONS. Elmer R. Tobey. The work of this department is cooperative with members of other departments and includes studies with milk, blood, and udder tissue in the dairy projects; with soil and fertilizers in plant nutrition problems; and with feeds in connection with the problem of nutrition and growth in poultry. The results of these studies will be incorporated in the final published reports of the various projects.

ENTOMOLOGY

BLUEBERRY POLLINATION. Clarence R. Phipps, Frederick B. Chandler, and Irvin C. Mason. The cage experiments initiated in 1931 were continued in 1932. Thus, clons of *Vaccinium pensylvanicum* and *V. canadense* were enclosed with honeybees in order to note the influence of the bees upon fruit set. This experiment included the caging of plants which were bearing their first crop after burning. Where parts of several clons were represented in a single cage and enclosed with bees the per cent of fruit set was more than double that recorded in similar cages containing bees and plants of only one clon.

In another experiment an effort was made to determine the period during blossoming when insects are most efficient in their work of pollinating the plants. A large cage six feet square and six feet in height was employed to house a hive of bees. Connected with one side of this tall cage (see Fig. 36) was a long narrow cage. This unit was divided by movable vertical partitions into four sections each three feet in length. The bees were allowed to visit the blossoms in the first section during the first part of the blooming period and later the other sections were exposed in turn. The yield was greatest in the section which was first exposed and diminished progressively in each succeeding section.

WIREWORMS. John H. Hawkins. That part of the Maine potato crop which received shipping point inspection during the season of 1930-31 was damaged by wireworms to the extent of \$383,-

000.* Potatoes thrown out because of wireworm injury at the points of inspection during the season 1931-32 caused a loss of \$59,000. These figures represented but a part of the loss caused to the potato crop by wireworms during these seasons as no data could be obtained on damage caused to that part of the crop which was not inspected when shipped. Moreover no account is taken of injury to seed or growing potato plants.



FIG. 36. One type of cage used in the study of blueberry pollination.

After infested soil has been kept in cultivated crops for a period of three years it is usually relatively free from wireworms, and potatoes may then be grown with a reasonable degree of safety. A large share of the wireworm injury to potatoes can, therefore, be avoided by the use of a crop rotation which provides for keeping the land in cultivation.

*Figures furnished through the courtesy of Mr. C. M. White, Chief, Division of Markets, State Department of Agriculture, Augusta, Maine.

Seeding the soil to meadow grasses such as timothy and red top after it has once been freed from wireworms should not be the practice if potatoes are to be grown there again. It is recommended that potatoes be followed by a green manure crop after which they can again be planted. If a hay crop must be grown clover is preferable to timothy. This is because clover does not stand over so long a period of time, and therefore, wireworms would not have a chance to breed undisturbed as is the case where long standing grasses are planted.

Some promising results in the control of wireworms were obtained by treating the soil with naphthalene. Apparently naphthalene is not toxic to plants and may be safely used in the field where plants are growing. Kainit used in field tests for the first time in 1932 was also effective against wireworms. In addition to whatever insecticidal value it may have, kainit contains potash and magnesium which are needed in some soils.

Wireworms can be attracted to baits of sprouting seeds and graham flour dough buried in the soil. The addition of honey and molasses increases the attractiveness of the baits. Various poisonous substances are being tried in connection with baiting in an attempt to poison the wireworms after they have been attracted. The beetles which lay eggs from which wheat wireworms hatch are attracted to cut clover baits. Large numbers of these beetles were taken and from them eggs have been obtained and young larvae reared.

APPLE FRUIT FLY OR RAILROAD WORM. Clarence R. Phipps. Since the last report we have obtained additional information upon the dispersal habits of this insect. We also obtained many additional data bearing upon its life cycle and based upon records covering over 100,000 larvae and 30,000 flies.

Dispersal. In 1932 our results were in accord with those obtained in 1931. The experiment was conducted under somewhat different conditions than those of last season. The most important difference lay in the fact that there were many apples on the trees in which the marked flies were released whereas in 1931 the flies were released in trees from which the apples had been removed. The release trees selected in 1932 were separated from the recovery trees in some instances by extensive open fields. In spite of the presence of apples on the release trees the marked flies soon left

them, many flying across open fields for 125 yards or more. In all, 130 marked flies were recovered, some having traveled 233 yards and many having covered a greater distance than the maximum of 156 yards recorded in the 1931 experiments.

In cooperation with the Extension Service, we are conducting apple maggot control demonstrations in several orchards which were badly infested in 1930. The first step was to spray or remove all neglected apple or haw trees within a radius of 100 yards of the plantings. Timely spraying based upon fly emergence records and the prompt collection and destruction of drops have accompanied this program. Four of these orchards which produced practically no maggot-free apples in 1930 yielded fruits in 1932 that were from 90 to 100 per cent clean.

Life History Studies. In 1932, the flies began to appear in our cages in Cumberland Center on June 21st and in Monmouth on July 3rd. Emergence in these localities began on practically the same dates the preceding season. However, the emergence period was much more protracted the past summer, the height of emergence coming nearly two weeks later than in 1931. This delayed emergence was probably due to the unusually dry weather which prevailed in June and early July, 1932. Thus, the second spray application, if based upon the 1931 emergence, would not have afforded the needed coverage late in the summer. Since the flies were active late in the season and infested an unusually large proportion of late variety apples, it is not surprising that there are many reports of increased infestation in 1932. This condition illustrates the need of maintaining emergence cages in the principal apple growing sections each season if the sprays are to be effectively timed.

Our records indicate that the majority of the early emerging flies are females whereas most of the late emerging individuals are males. On the basis of daily counts, sex determinations were made of 22,750 flies in two localities in 1932. It was found that the period during which the sexes were appearing in equal numbers coincided with the peak of emergence. If this correlation is supported by further studies, it may be possible to predict the period of maximum emergence or at least to recognize it before it has definitely passed—an important feature from the standpoint of applying the second spray.

Some larvae spend two winters in the ground and emerge the second summer. Such flies are known as two-year cycle individuals. Cages established in Cumberland Center in 1930 yielded 131 two-year cycle flies in 1932. At Monmouth 80 two-year flies appeared. These numbers represented 8.5 and 5.2 per cent, respectively, of the total emergence in these two cages in 1931.

INSECTS IN RELATION TO VIRUS DISEASES OF POTATOES.
Geddes W. Simpson. During the season of 1932, seed plot work was continued in six sections of Aroostook County. Four of these plots were planted with the progeny of the respective 1931 plots. The others were begun in 1932. Differences were found in the spread of mild mosaic in 1931 in different sections of the County. In one case there was no increase in mild mosaic and a decrease in leafroll while in the other three plots spread was evident.

Additional counts were made of the relative abundance of the three species of aphids known to transmit virus. There is some evidence to indicate that the aphid populations differ in various sections of the County.

The collection of insects present in Aroostook potato fields was increased during the 1932 season.

Tuber indexing work is again in progress in the greenhouse. With the space available in the new greenhouse, larger numbers of plants are being grown this winter.

Transmission studies in cages in 1931 gave negative results. Various insects other than aphids were tested. Small numbers of aphids were likewise found ineffective when transferred to healthy plants late in the season.

In certain sections of Aroostook County it would seem possible to maintain Green Mountain foundation stock at least a second year without an increase in mild mosaic, if sufficient effort is expended in roguing. The problem is somewhat simplified when the stock is relatively free from disease when introduced into the County.

APHIDS. Edith M. Patch. The time devoted to the aphid project during the past year, has been concentrated on the records of the food-plant range of economic species. It is necessary to have such data available for reference in order to avoid certain confusions in future experimental work with this group of insects.

HOME ECONOMICS

ELECTRICAL COOKERY. Lolie Smith, Merna M. Monroe, and Pearl S. Greene. Summaries of the reports obtained from Farm Bureau and Federated Club women in the survey of cooking practices have been completed and are now ready for publication. In addition to the summaries previously reported is the following:

The range oven was employed one to two times daily with an average daily duration of over one and one-half hours. With the exception of the days on which beans were baked, there appeared to be few regular baking days; instead, the baked goods were freshly prepared for consumption. These baked foods were usually cooked singly rather than simultaneously; only one pan was used in the oven in half of the oven processes and two pans were used in a fourth of the processes. The baking processes, except baking of beans, were generally of short duration and were often intermittent rather than consecutive; they consisted chiefly of the baking of hot breads, potatoes, and pies.

From this summary it appears that a small oven of low thermal capacity and, therefore, of reduced preheating cost may more nearly meet the family's daily needs than a large oven of high thermal capacity and of high preheating cost.

From the records of 2,697 days' menus served in Maine families, a typical menu for a family of four was selected as the basis upon which to study the heating equipment, the utensils, and the management problems involved in electrical cookery.

Small pieces of equipment such as electric percolators and toasters, which have low thermal capacity and are compactly constructed in such a way that a greater proportion of the heat generated is directed to the food to be cooked, have been found to be more economical of electrical energy than the range surface and the oven. When brewing coffee, an electric percolator consumed approximately 45 per cent less electrical energy than the non-electric percolator on a small open unit. In toasting bread on an electric toaster and in an oven, the electric toaster consumed one-half as much electric energy as the range oven. An electric bean pot is also being tested for its comparative efficiency to that of an oven.

Since the greater proportion of the heat in an electric oven is radiant heat, the amount of the oven heat received by the food to be

cooked depends largely upon the color and surface texture of the oven utensils. Tests conducted showed how much these factors affect the amount of electrical energy consumed when biscuits are baked on sheets of American Russia iron, aluminum, glass, and tin. When American Russia iron was used, biscuits were baked to an equal doneness with 16 to 30 per cent less electrical energy than when they were baked on aluminum, glass, or tin.

Because the survey indicated the importance of the use of the oven in relation to cost of operating an electric range, extensive laboratory tests have been made to determine economical operation of the electric oven.

In the use of the coal or wood range, baking processes have for obvious reasons been organized around the technique of pre-heating the oven almost if not quite to the desired baking temperature, and most of the commonly accepted directions for electric range baking accept this procedure as a starting point, and suggest economy only by indicating the minimum time necessary to reach the accepted temperature. In an electric range, for a single short baking, the preheating is the most expensive part of the process. In baking biscuits, for example, it may require 75 per cent of the total energy consumed. In this particular instance, it is possible to omit the preheating period, putting the biscuits into the oven when the electric current is first turned on, provided the rate of heating is satisfactory.

With an electric oven of 3,500 watt capacity, so constructed as to reach 518° F. in 10.2 minutes, it was possible to bake biscuits to a satisfactory standard of doneness, lightness, shape, and color without preheating the oven. The energy consumption was about one-sixth of a kilowatt hour less than that used when the oven was preheated according to the usual directions, or nearly 20 per cent less. However, in an oven of 2,200 watts, which required 15.2 minutes to heat to the same temperature, the biscuits failed to bake satisfactorily in a non-preheated oven. In producing biscuits of the desired shape and color, the proportion of ingredients, the kind of baking powder, the method of mixing, and the type of utensil may be controllable factors; in which case they could be modified to permit successful baking without preheating the slow oven. In regard to equipment, the desirability of small ovens of low thermal capacity is again evident because they could be designed to give rapid

heating at low wattage, and the additional economy obtained by omitting or minimizing the preheating time could be combined with a low operating cost.

If more than one food is to be baked in the oven, the economy of simultaneous baking is possible in certain combinations, where the nature of the foods permit. If not, the routing of a series of baking processes so that one follows another immediately, spreads the cost of preheating over several processes. For example, half of the electrical energy necessary to bake an apple pie was used in preheating the oven.

With the ordinary range used for family size cooking and with the equipment now on the market, a single food can be brought to and maintained at the boiling point or a solid food, such as meat, can be brought to the desired internal temperature more economically on a surface unit than in the oven. This is because of the necessity of keeping the large mass of metal and insulating material of the oven at a high temperature. If, however, more than one surface unit is required at a time, the point may be reached where cooking all the foods simultaneously in the oven is more economical than surface cooking; for this reason the oven meal is popularly recommended as an economy measure. However, in a series of experiments in which pork shoulder, green beans, and potatoes were cooked by both methods, surface unit cookery was more economical by 47 per cent. The oven meal, therefore, should be considered an economy only when one of its constituents must necessarily be baked. In this case the added cost of cooking the second and third foods in the oven should be balanced against the cost of cooking them on the surface. For example, cooking potatoes and beans in the oven with a roast added 16 per cent to the cost of operating the oven, but the total cost of this oven meal was 10 per cent cheaper than that of oven roasted pork with surface boiled beans and potatoes.

In range-top cookery, the wastefulness in the use of utensils unsuited in size to the heating unit was investigated. A procedure so common as the use of a kettle two inches smaller in diameter than an eight and one-half inch unit, for heating one quart of water, proved to be 30 per cent more expensive than the use of a kettle corresponding exactly in size to the unit.

While it is well known that electricity at the usual domestic range rates is an expensive source of water heating, so that both special apparatus and special rates are necessary to make it compare equally with other means of heating water in quantity, it is sometimes necessary to rely on the range for heating dishwater at certain seasons. It was found that heating five quarts of water to boiling three times a day increased the cost of operation nearly 40 per cent of that necessary for the preparation of meals alone. But this amount could be reduced one-third by utilizing immediately the heat in a unit preheated for use in a previous cookery process.

COOKING QUALITY OF POTATOES. Marion D. Sweetman and Pearl S. Greene. Data secured on the measurement of various qualities of potatoes in relation to their mealiness have been summarized and lead to the following conclusions:

- (1) The quantity of starch (determined as dry matter) is significantly but not perfectly correlated with mealiness.
- (2) Sloughing is positively correlated with mealiness and also with the amount of starch.
- (3) The hydrophilic quality of the starch, as measured by comparative increases in viscosity during heating, is not related to mealiness.
- (4) The amounts of soluble pectin and of protopectin are not related to mealiness.
- (5) The data at hand do not supply a simple chemical test for mealiness.

PLANT PATHOLOGY

POTATO DEGENERATION DISEASES. (In cooperation with E. S. Schultz, W. P. Raleigh, and C. F. Clark, of the Division of Horticultural Crops and Diseases, United States Department of Agriculture.)

Effect of the Amount of Disease on the Yield, in Northeastern Maine. Reiner Bonde. From records on yield tests made in 1918, 1923, 1924, 1925, 1927, 1928, 1929, 1930, 1931, and 1932, the losses from 100 per cent mild mosaic in Green Mountains ranged from 10 to 33 per cent, with an average of 21 per cent. In various tests

smaller percentages of this disease gave less proportional reduction in yield per 10 per cent of disease. Therefore the chief danger is in natural increase up to 80 per cent or more and in the consequent greater reduction in yield.

Natural and Experimental Transmission in Green Mountains in Central Maine. Donald Folsom. Three tuber lines in their second year of multiplication were grown near the middle of Highmoor Farm in 1931. They were respectively about 1,650, 2,100, and 2,850 feet from the nearest diseased potatoes (two acres containing about one per cent leafroll, a trace of mosaic, a trace of spindle tuber, and a trace of yellow-top) and about 900 feet further from the nearest severely diseased potatoes (containing much leafroll and some mosaic). In 1932 they were still better isolated and the disease content was respectively: 0.7 per cent yellow-top, 0.1 per cent leafroll, and a trace of spindle tuber for the first tuber line; 2 per cent leafroll for the second; and 1.7 per cent leafroll for the third. Therefore a half-mile of isolation was not enough to prevent invasion by leafroll carriers in 1931. At the same time, roguing 1 per cent leafroll out of the two acres in 1931 resulted in a decrease of leafroll, there being only 0.1 per cent in 1932 in this stock.

The half-mile isolation was across cultivated fields and pasture. No other kinds of cultivated perennial solanaceous plants (those of the potato family) were grown in the vicinity. No solanaceous weeds were present except *Solanum Dulcamara*, about 1 plant to each 60 acres, and these appeared healthy and were free of aphids. Storage of the tuber-lines was in rat-proof containers, nailed shut except in the field when being dug and when being planted. These results appear to be explained better as instances of insect transmission over the distances given, than on the basis of the diseases remaining masked through two growing seasons, being transmitted from non-solanaceous plants, being transmitted by wind, or resulting directly from maladjustment to the environment.

In central Maine, three Green Mountain stocks were observed to be free of mosaic in 1931 at distances from other potatoes of about 500, 1,100, and 3,000 feet, respectively. The third one also was free of leafroll. Mosaic and leafroll appeared in 1932 (in 0.7 to 4 per cent) after the potatoes had been stored by the growers, who were desirous of maintaining healthy seed. Less authenticated

records indicate that seven other growers who were fortunate enough to plant mosaic-free stock in 1931, at isolations up to a mile, found the disease present in 1932.

In 1931, healthy Green Mountain potato vines were exposed to infection by leafroll through several agencies, with the following results appearing in the progeny in 1932: no transmission by 160 or 250 flea beetles; no transmission by contact of roots and shoots in the five cages used for such inoculation alone, or in seven used for insects; transmission by *1,500*, *1,000*, *450*, *350*, or *250* buckthorn aphids per cage, but not by *130*, or by *40* together with one potato aphid; transmission by *1,400* or *500* potato aphids per cage, but not by *150*, *80*, or *12*; transmission by two spinach aphids and *10* buckthorn aphids together. The five untreated check cages remained healthy. Italicized numbers above are of aphids introduced on leafroll leaves laid on healthy plants, while the other numbers are of aphids put on leafroll plants in the same cages as the healthy and allowed to disperse at their leisure. It is to be concluded that under apparently similar conditions, an increase in the number of aphids gives a greater amount of infection.

Resistance of New Seedling Varieties to the Latent Mosaic of Green Mountains. E. S. Schultz and W. P. Raleigh. Leaf-rubbing and tuber-graft inoculations with latent mosaic, which is generally present in masked condition in Green Mountains and other important potato varieties, have failed to infect certain potato seedlings, while similar inoculations on other seedlings have infected every plant. Under field conditions these potato seedlings have reacted like the artificially inoculated plants, viz., certain seedlings have not contracted latent mosaic, while others similarly exposed became infected. Observations on the reaction of different potato varieties and seedlings to latent mosaic indicate that some manifest this disease as severe necrosis, while others are very resistant to it.

*Isolation of Crinkle, Leafrolling, and Rugose Mosaic, Stipple Streak and Leafroll from Latent Mosaic by Means of *Macrosiphum solanifolii*.* E. S. Schultz, W. P. Raleigh, and Reiner Bonde. In 1931 Green Mountains affected with crinkle, leafrolling, and rugose mosaic, and with leafroll, and Rose 4 affected with stipple streak, harbored latent mosaic. They were colonized with potato aphids (*Macrosiphum solanifolii*). The different types of diseases used in these tests have been cultured on potato under muslin-cov-

ered cages for several seasons at Presque Isle, Maine. This work was conducted to determine whether aphids could be used to isolate different types of virus diseases from latent mosaic which is harbored in masked condition and is present quite generally in most of our important commercial potato varieties. At the same time observations were made on the relation of stem-end browning and net necrosis to latent mosaic.



FIG. 37. A general view of insect cages used in the study of the transmission of virus diseases of the potato.

After the aphids had fed on the diseased plants for about two weeks, transfers, including approximately 50 aphids per hill, were made to healthy Green Mountain seedlings, which in foliage characters closely resembled commercial Green Mountains. Inasmuch as the healthy seedling tops were 15 to 20 inches tall when they were inoculated with aphids, current-season symptoms did not appear except on the tops infested with aphids from crinkle mosaic. With this disease distinct mottling appeared in the apical part of the plant during the same season.

Observations on the inoculated seedlings in the second generation disclosed that the seedlings inoculated with aphids from leaf-rolling mosaic plants manifested rolled and somewhat diffusely mottled leaves; seedlings inoculated with aphids from crinkle mosaic plants manifested faintly mottled, rugose and slightly ruffled leaves; seedlings inoculated with aphids from rugose mosaic plants developed rugose and vein-cleared leaves; and seedlings inoculated with aphids from stipple streak plants developed streaked, curled, and badly dwarfed plants which were typical for second generation streak in Green Mountains. Seedlings inoculated with aphids from leafroll plants manifested typical leafroll symptoms.

Leaf-rubbing inoculations were made from the Green Mountain seedlings with crinkle, leafrolling and rugose mosaic, and streak and leafroll, to *Datura stramonium*. These inoculations failed to produce infection, which indicates that latent mosaic apparently was not transmitted by *Macrosiphum solanifolii*.

Some tubers from the seedling plants inoculated with leafroll-carrying aphids developed net necrosis and leafroll, while other tubers which failed to contract leafroll manifested stem-end browning. Since leaf-rubbing inoculations from these plants to *Datura stramonium* and tobacco failed to produce symptoms, it seems apparent that latent mosaic was absent and apparently not associated with net necrosis or with stem-end browning.

Stem-end Browning of Potatoes. Donald Folsom. Bushel samples were saved in 1931 from various fertilizer treatment plots of potatoes and were examined for stem-end browning in the spring of 1932. Samples from 58 plots gave a range of 0 to 2 affected tubers out of 50. With so little injury, and with these extremes shown by two readings from one lot, the trouble could not be associated with any kind of fertilizer treatment. Neither could it be correlated with location in the field. Incidentally in the sample from one no-fertilizer plot, there was an unusual amount of wilting at the stem end, and with this was purple blotching like that due to frost.

*ROTS OF POTATO TUBERS AND SEED PIECES. Potato Tuber Rot Caused by the Gray-Mold Fungus (*Botrytis cinerea*).* Donald Folsom. *Botrytis cinerea* has been readily isolated in different seasons from a rot of potato tubers stored in Maine. In this type of rot

the skin becomes wrinkled while the flesh under pressure easily loses water. Where advancing rapidly the rot causes a temporary darkening of the flesh. Different cultures of the fungus, including some isolated from potato foliage and stems during an epidemic of *Botrytis* blight in the field, have, under certain conditions, caused the same kind of rot as that found in storage. A different form of rot also has been obtained under certain other conditions, where all inoculations have been successful but where the lesion did not penetrate more than one or two centimeters deep. The fungus has been reisolated, reinoculated, and again reisolated, without particular difficulty except where conditions were very favorable for wound repair.

Reduction in Stand of Potato Plants. Reiner Bonde. Surveys made in various parts of Aroostook County in 1932 indicated that poor stands were exceedingly common. Information secured showed that approximately 20 per cent of the seed pieces planted had failed to grow.

Isolations from diseased seed pieces indicated that much of this decay was due to various kinds of *Fusaria*. Previous studies indicate that this type of seed piece decay has its origin in the bin at cutting time. Proper storage and suberization of the seed pieces prior to planting are factors having a very direct bearing on the problem.

Experiments conducted on Aroostook Farm indicate that these seed-piece troubles vary greatly from season to season. It appears that the trouble can be reduced considerably by cutting the seed into well ventilated crates and drying it quickly before the contaminating organisms have had time to form the primary lesions.

It is believed that the practice of cutting seed into barrels and dumping these into large poorly ventilated piles is one of the causes for the poor stands that exist some seasons.

Rhizoctonia was also very severe in 1932 and caused much loss in the form of uneven stands. It is felt that in years of much late blight, when the fields die earlier than usual, that a heavy infection of *Rhizoctonia* sclerotia is formed on the potato tubers. This heavy tuber infection associated with a reduction in the practice of seed treatment results in a loss due to this disease. It is believed that similar losses may occur in 1933 and that seed treatment therefore may be profitable.

POTATO SPRAYING AND DUSTING. Reiner Bonde. These data apply only to the Green Mountain variety in Aroostook County, unless indicated otherwise.

The potato spraying and dusting experiments conducted during the period from 1929 to 1931 are summarized in Maine Experiment Station Bulletin 362.

General Conditions. The season of 1932 was characterized by a very extensive and severe epidemic of late blight in Aroostook County. The losses from this disease probably would amount to 10 per cent of the entire crop. The reason for these extensive losses was in part due to the general economic condition in the County which tended to reduce the amount of fungicide used. Many farmers because of insufficient funds made fewer spray applications than they normally would have made. This situation and the ideal weather conditions for late blight development, resulted in much loss through early killing of the foliage and from tuber rot.

The local dealers also because of the prevailing economic conditions failed to stock up sufficiently to meet the demand brought about by the late blight epidemic. As a result many fields did not receive the late sprays that were necessary for proper blight control.

Spray Service. The potato spray service, started in 1931 under the direction of the local Farm Bureau and aided by the Experiment Station workers, has increased immensely in popularity among the farmers. In 1932, three hundred and eleven farmers cooperated in this service and received timely spray warnings and information regarding the general disease situation in the County. According to the County Agent's report, 2,605 acres of potatoes were included in the fields that were sprayed following the schedule suggested by the plant pathologists on Aroostook Farm. The individual growers received cards informing them in advance when it was intended to spray on Aroostook Farm. Spray warning notices were also broadcasted by the local radio station and through newspaper articles.

The results from these cooperators have not been summarized thus far but field observations indicate that the spray service had a beneficial influence on the spraying practices of the growers.

One grower reported that one field sprayed four times as was his customary practice yielded 116 barrels per acre. Another field also sprayed four times in the same manner yielded only 92 bar-

rels per acre. According to this grower the field included in the spray service and sprayed eight times following the schedule used on Aroostook Farm, yielded 135 barrels per acre. This greater yield secured by the grower was without doubt a direct result of the Spray Service. Probably other growers have been aided in a similar manner.

Comparison of Home-Mixed and Commercially Prepared Copper Lime Dusts. During the summer of 1932 there was considerable interest in the use of "home-mixed" copper lime dust for



FIG. 38. Late blight has a firm grip on this leaf.

the control of late blight in Aroostook County. This interest was stimulated because of the serious economic conditions prevailing and the need for a reduction in the cost of potato production. Inquiries became so numerous regarding this problem that some plots on Aroostook Farm were devoted to a comparison of "home-mixed" and commercially prepared dust.

The home-mixed dust was prepared in a home constructed barrel mixer using 25 pounds of monohydrated copper sulphate to each 75 pounds of hydrated lime.

The home-mixed dust cost from \$2.50 to \$3.00 per hundred pounds for materials and mixing. By home mixing the cost of dust can be reduced from \$1.00 to \$3.00 per hundred pounds, or to a cost approximately the same as that of Bordeaux mixture.

The home-mixed and the commercially prepared dusts were compared as to influence on yield and disease control. With the home-mixed preparation the yield was 144 barrels per acre and in the adjacent plots dusted with commercial dust the yield was 138.5 barrels. The difference of 5.5 barrels is too small to be considered significant for these tests. There was no appreciable difference in the degree of disease control and so the two types of dust can be considered as being about alike in this respect if properly prepared and of the same copper content.

Comparison of Bordeaux Mixture with Copper Lime Dust. During the summer of 1932, dust and Bordeaux mixture were compared under very severe late blight conditions. The power sprayer using the 10-10-100 formula gave a perfect control against late blight and the yield was significantly superior to that obtained with the home-mixed dust. Plots sprayed with Bordeaux applied with the power outfit yielded 401 bushels or 146 barrels per acre and approximately seven barrels more per acre than the dusted plots.

Bordeaux mixture (8-8-100) applied with a horse-drawn wheel-traction rig also appeared to give slightly better yields than did dust. Both treatments afforded good disease control under extremely severe late blight conditions.

Comparison of Different Strengths of Bordeaux Mixture. The yield data for 1932 indicate that a 10-10-100 formula applied with a power machine is the most efficient treatment when late blight is very prevalent. Half strength Bordeaux applied with the power

machine also gave good disease control but was less efficient than the full strength toward the latter part of the season and yielded slightly less. Bordeaux mixture 8-8-100 applied with a horse-drawn wheel-traction machine also was very effective in controlling disease but was less so than full strength Bordeaux mixture applied with a tractor power machine.

Marl as a Substitute for Lime in the Preparation of Bordeaux Mixture. During the past few years a few farmers in the vicinity of Nadeau Lake (Limestone) have made a practice of using marl as a substitute for lime in their spray formula. Marl is relatively cheap, being obtained from an old lake bottom. This material is approximately 90 to 95 per cent pure calcium carbonate.

Marl contains approximately 30 per cent less calcium than hydrated lime and it would appear therefore that a correspondingly larger amount of marl should be used for the best results. It was found that, because of the sediment resulting in mixing the marl with water, it was necessary to use a 13-10-100 formula to avoid burning of the young foliage. The fungicide made in this manner gave good disease control when tested against a very heavy epidemic of late blight. It possibly was slightly inferior to Bordeaux mixture as a fungicide.

Copper Cyanamid as a Fungicide for the Control of Late Blight. Copper cyanamid was found to possess considerable fungicidal value. However, in these extremely strenuous tests this material was not as effective as was Bordeaux mixture.

The Effect of Spraying Irish Cobblers After the Blooming Period. There is a common feeling among farmers in Aroostook County that it is bad practice to spray Irish Cobblers after they have bloomed. This opinion is so generally believed that many growers stop spraying this potato variety at a time that is often the most critical.

Tests with growers in 1932 showed that the above impression is false and that spraying Irish Cobblers after the blooming period does not hasten maturity or reduce the crop yield.

Studies on the Resistance of Potato Varieties to Late Blight. The variety known locally as Rust Proof was tested further for blight resistance in 1932 under extremely severe field and laboratory disease conditions. In these tests this variety was found to be

very resistant to both foliage blight and tuber decay. The extent of this resistance is shown by the following yield data for 1932.

TABLE 3

*Yield Comparisons of Unsprayed Plots Grown Under
Very Severe Late Blight Conditions*

Variety	Yield Barrels per acre	Percentage decay
Green Mountain	48.0	48.0
Giant Hill G.M. (very late maturing)	52.0	29.0
Rust Proof	117.0	0

Seven other seedlings from this variety have been secured through Mr. Paisley of Albert, New Brunswick, Canada. All of these are resistant to late blight and one appears to be considerably earlier maturing. Studies are being conducted to discover the nature of the resistance of the Rust Proof variety to infection by late blight. Studies are also under way to determine more definitely the origin of late blight infection and the conditions necessary for an epidemic.

A HOME-MADE COLLOIDAL COPPER SPRAY. W. P. Raleigh. An attempt has been made to perfect a method of home manufacture of a colloidal copper spray. In preliminary tests several procedures were followed and many colloidal materials were used in an effort to get a concentrated mixture in which the copper was in a finely divided state. One of the most promising concentrates was made in the following manner: one pound of copper sulphate was dissolved in two quarts of water and one pint of black-strap molasses was added. This mixture was stirred well and made slightly alkaline by adding about four-tenths of a pound of lye dissolved in one quart of water. This concentrate was allowed to stand until it turned yellow, which usually required about a day at room temperature. In preliminary field tests this mixture, used at the rate of the equivalent of four pounds of copper sulphate to 50 gallons of water, gave satisfactory control of late blight of potatoes. It is

especially adapted to conditions where excessive coverage of the foliage is not desired. Mosaic may be readily read in potato fields sprayed with this material, whereas it is often difficult to read it in fields sprayed with Bordeaux mixture. The spraying procedure is very simple after a quantity of the concentrate is made up.

POTATO SEED TREATMENT. W. P. Raleigh and Reiner Bonde. Laboratory tests and preliminary field experiments indicate that the addition of potassium iodide to a solution of mercuric chloride greatly increases the fungicidal efficiency of the solution when used to control Rhizoctonia on potatoes. A 1:1,200 solution of mercuric chloride, to which 0.25 per cent potassium iodide was added, when used as a dip treatment, proved to be almost as efficient in control of Rhizoctonia as a 1:1,000 solution of mercuric chloride used as a one and one-half-hour soak. It was more efficient than a 1:500 solution of mercuric chloride used as a three-minute soak or a 1:500 solution of mercuric chloride, with one per cent commercial hydrochloric acid, used as a dip. A two per cent solution of potassium iodide, as a dip, did not give satisfactory control of Rhizoctonia in laboratory tests.

The 1932 seed-potato treatment experiments on Aroostook Farm again indicate that, when Rhizoctonia-infected seed is planted, a significant increase in yield may be expected as a result of treatment. The increases in yield this year ranged up to about 17 barrels per acre. The standard corrosive sublimate treatment and the acid corrosive sublimate treatment (four ounces corrosive sublimate to 15 gallons of water, plus one per cent commercial hydrochloric acid, used as a three-minute soak) were among the best treatments used. The organic mercury dips were slightly inferior in control of Rhizoctonia this year. Irish Cobblers that have been grown on Aroostook Farm for five seasons and selected as free from Rhizoctonia showed only a trace of Rhizoctonia even in the untreated lot.

APPLE SCAB CONTROL. Donald Folsom. On Highmoor Farm in 1932, in a McIntosh orchard 19 years old, the addition of iron sulphate to dry lime sulphur spray was tested at the rate of three-fourths pound to 50 gallons at three applications. The result was a significant decrease in leaf burning and a significant increase in yield. With the iron sulphate there was also superiority in scab control and a lessening in the amount of fruit russetting.

In this orchard, growth was completed by September 20. By growth is meant increase in girth of the trunk, which was measured monthly. Noteworthy correlations between growth, yield, and other characteristics, were found to be as follows:

The more a tree yielded, the less it grew.

The more a tree grew last year, the less it grew (and the more it yielded) this year.

The less a tree yielded last year, the less it grew (and the more it yielded) this year.

The more a tree yielded, the smaller were the fruits.

In brief, even if spray injury to leaves seems to reduce total yield, there may be compensation in larger fruits, in more growth, and in more yield the next year. Therefore to learn the effects of a given kind of spray or dust, the same treatment should be given to a group of trees over a period of years. This is being done in the young McIntosh spray orchard.

In 1932, in these small McIntosh trees, lead arsenate reduced leaf scab somewhat and caused the most spray injury. Averages for the different treatments are as follows:

	Leaf examination July 26			Stem diameter (mm.)		
	Trees	Scab %	Burned %	Trees	Increase	Final
Sulphur dust	9	2	3	66	11	40
Do	9	2	5			
Sulphur dry mix	9	3	2	69	11	41
Do	9	3	3			
Dry lime sulphur	10	2	17	69	10	38
Do	9	1	19			
Lead arsenate	9	4	21	68	10	39
Do	9	5	30			
Nothing (checks)	9	17	3	75	10	38
Do	9	21	3			

In the leaf examination the two figures for each treatment represent respectively all trees of plot 1, and tree 3 of each of the nine plots. Individual tree records gave significant differences in the following:

Leaf scab, plot 1, nothing (checks) over all others.

Leaf scab, tree 3, between all except between dust and dry lime sulphur.

Leaf burning, dry lime sulphur and lead arsenate on the one hand over all others on the other hand.

Diameter increase, sulphur dust and sulphur dry mix on the one hand over dry lime sulphur on the other hand.

Apparently the scab of the checks and the burning by the lead arsenate did not reduce the growth of the season quite as much as did the burning by the dry lime sulphur.

In seven untreated trees, tent caterpillars in the spring removed from 20 to 99 per cent of the leaf blades, averaging about 70 per cent. This injury reduced the growth to about 50 per cent of normal at the end of July, but by the end of the season the average reduction was only about 30 per cent. Final reduction was over half in three cases of almost complete defoliation.

The growth of the stems in diameter was measured every four weeks. It is of interest that diameter increase proceeded at about the same rate through June, July, and August, then slowed up, and was about completed before October 17.

At least eight McIntosh trees blossomed in 1932, at least six set fruit, and four produced altogether four mature apples. These were divided evenly between the sulphur-dry-mix and the lead-arsenate series.

In this young orchard we now have a five years' record on 370 trees that averaged about one-third inch in stem diameter when set out in 1928 and that average about one and one-half inches in stem diameter now. These trees include five major groups of about 70 trees each, characterized as follows:

- (1) Treated with sulphur dry mix spray for five years, now the largest.
- (2) Treated with sulphur dust for five years, now the next largest.
- (3) Treated with lead arsenate alone for five years, having the most leaf burning each year and now the third largest in average size.

- (4) Dry lime sulphur spray for five years, having the least scab each year and now the next to the smallest.
- (5) Flotation sulphur spray for three years; but with nothing put on the last two years, during which they had the most scab and dropped to fifth place in size.

The difference between the largest and smallest averages of size in the preceding series of five groups is only about six per cent. Probably a gain of one per cent a year is not worth the cost of spraying or dusting. To answer this question better, the comparison should be continued at least until the trees have borne fruit for a year or more.

The difference of six per cent in size between treatments is much less than the average differences in different soils such as sandy, clayey, and mucky modifications of the fine sandy loam of the orchard. Kinds of stocks had very little effect, if any, on average size. Although the 70 trees receiving each treatment are in plots scattered through the orchard to make allowance for differences in location and soil, it is possible that some of the six per cent difference referred to is due to an average difference in environmental conditions.

Because of the marked differences found due to soil, in 1932 a soil boring was made near each of ten backward trees and usually near a nearby thrifty tree. With one exception, the backwardness could be blamed upon sand or clay subsoil being close to the top. The exception may be a case of inherent lack of vitality.

The general conclusion seems to be that differences in spray or dust treatment may have had a slight effect upon growth rate through influencing the amount of leaf scab and leaf burning, but such effect is not as great as might be expected and to date does not justify the expense of any treatment except an application of lead arsenate against tent caterpillars or any other insects causing defoliation similarly.

A new spray method, developed and used by Superintendent Cheney on bearing trees, applied the spray from on top of the spray-rig through an eight-nozzle gun instead of from the ground through a single-nozzle gun. This gave a more thorough application, especially in the tops, resulting in better scab control with somewhat more spray injury to leaves and fruits.

CUCUMBER DISEASE CONTROL. Donald Folsom. *Dusting Experiment.* In 1932, copper-lime dust containing calcium arsenite was applied weekly to cucumbers starting as soon as the plants were up, in order to check scab (caused by *Cladosporium cucumerinum* Ell. & Arth.). In one plot where the disease was abundant in 1931, as compared with another plot where the ground was clean but diseased plants were growing nearby, there was a poorer stand, possibly due to the scab in the soil. There was also more wilt, probably due to the presence of more beetles which might be perpetuating the disease from 1931 in that location. There was a lower percentage of scabby fruits, probably due to the poorer stand and the accompanying better ventilation, and there was a lower total yield. There was less yield of clean fruits, due to the influence of the lower total yield and despite the smaller scab percentage.

In each plot each 30-foot row was planted either in a drill or in three hills. The drill method, as compared with the hill method, decreased the size of the plants at first, probably due to the absence of stable manure and its warming effect. With drills there was less wilt and a significantly lower percentage of scabby fruits, possibly due to less attractiveness at first to insects which might be carrying disease. There was a decrease in total yield per row, probably due to later development of plants. There was a greater yield rate of clean fruits, due to the smaller scab percentage and despite the smaller yield.

In each plot and in each section—drilled and hilled—dusted rows alternated with nondusted rows. Here dust reduced the size of plants, decreased wilt 50 per cent, and significantly decreased the percentage of scabby fruits (on weight basis, in a series of mid-season pickings) from 46 per cent down to 35 per cent in one plot, and from 71 per cent down to 40 per cent in the other plot. However, at the last picking, made on August 22, 48 per cent of the dusted fruits were scabby in one plot and 64 per cent in the other. These percentages on August 22 probably would have been greater had the fruits been allowed to grow beyond the pickling size. Dust decreased the total yield at first, but increased it as scab became severe; that is, scab apparently hurt the yield as well as the quality and did so more in the absence of the fungicide.

Dust increased the yield of clean fruits, doing this much more as the severity of scab became generally greater during the season.

When the weights of the several pickings made in mid-season were combined they showed a gain in total yield, from dusting, of 10 per cent in one plot and of none in the other plot. The gain in clean fruits was 32 per cent in one plot and 107 per cent in the other, being respectively about 400 pounds and 2,000 pounds per acre in response to about 660 pounds of dust per acre costing about \$50 exclusive of application costs. This cost would be met if the clean fruits brought 12.5 and 2.5 cents a pound respectively for the two plots.

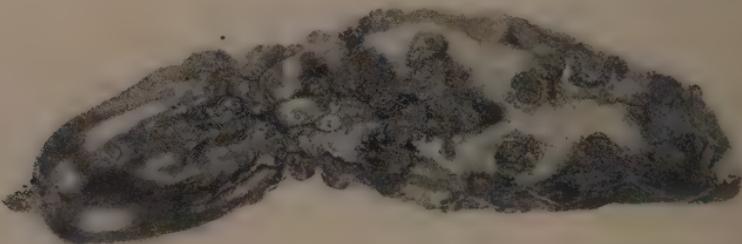


FIG. 39. A cucumber with a very severe infection of scab.

Inoculation Experiments. Commercial seed that showed no sign of the disease was inoculated and planted in the field. As a result the very young seedlings were infected and either did not emerge from the soil or were badly crippled, and no fruits had been formed by August 29. Inoculation in the field in the first-leaf stage also crippled the plants and practically eliminated fruit production. Inoculations in cages, with insects kept out, resulted in much less stem infection and dwarfing than in the open field, but fruit formation was absent here also, due to lack of pollination. Thus circumstantial evidence points to insects as aggravating factors in cucumber scab. These inoculation experiments led the way to the securing of a good field test of resistance in new strains that have been developed and that have shown resistance in preliminary tests in the greenhouse.

BLUEBERRY DISEASES. Florence L. Markin. Foliage diseases appeared to have caused less injury to blueberry plants in 1932 than in 1931.

Sclerotinia twig-blight and fruit-rot have been declining in Maine since 1929. Very little of the disease was apparent in 1932.

The brown leaf-spot (*Septoria sp.*) nowhere caused the complete destruction of foliage that it had in 1930 and 1931 in some areas in south central Maine. This fungus has shown a decided preference for the leaves of new succulent shoots in natural field infections.

The red-leaf disease (*Exobasidium vaccinii* (Fckl.) Wor.) appears to be increasing. The disease is not always controlled by burning as was shown by the fact that in plants previously infected, but burned to the ground in the springtime, the disease again appeared in the unfolding leaves of the new stems. This occurred about a month before spores developed on the leaves.



FIG. 40. Control of foliage diseases of the low-bush blueberry. Representative samples from an area where mildew and leaf rust were severe. Left, three stems from a plot which had received two applications of copper-lime dust. Right, four stems adjacent to the above but from a plot which had received no treatment. Note the shrunken berries and stems and the absence of leaves on the untreated specimens.

Leaf rust and mildew were common again but sporulated lightly during the summer months.

Witches' broom. Teliospores of this rust (*Calyptospora columnaris* Kühn) from both high- and low-bush blueberries (*Vaccinium corymbosum* L. and *V. pensylvanicum* Lam.) germinated in two days after being taken from outdoors and placed under bell jars in the greenhouse early in February. Inoculations were made on young needles of fir trees (*Abies balsamea* (L.) Mill.) by suspending the diseased blueberry stems above them. Flecking appeared on some of the fir needles within four days but several days later had disappeared and was not definitely seen again until the ninth to eleventh day. Pustules began to form on the twelfth day and in sixteen days 100 per cent infection had occurred. The maximum spore production was reached in two to three weeks after the appearance of pustules.

Many flecks did not develop into pustules when the trees were kept in dry air. However, when the trees were removed at intervals to humid conditions pustules continued to develop from the flecks until as long as two months after inoculation. The appearance of a few pustules on fir needles until late in the summer has been noted in the field.

Blueberry plants with young tender leaves were inoculated by spraying with aeciospores from the fir. This was during April in the greenhouse. Witches' brooms began to appear in three months but discontinued growth until the advent of cool weather in October. An incubation period of three months under natural conditions would place the time of the appearance of the disease in October. Brooms do appear on previously healthy plants, out of doors, in October and it is believed that they arise from the current year's infection. Observations indicate, however, that symptoms usually appear in the springtime. This would place the incubation period of the witches' broom stage in blueberry at approximately one year.

Observations indicate that under natural conditions the period of teliospore germination in blueberry stems is quite limited, but that the aecial stage on fir may not develop for a considerable length of time after inoculation.

Fir trees in the vicinity of the North Sedgwick nursery were removed during the spring of 1931. Whereas, previously about

25 per cent additional high-bush plants in the nursery became infected annually (a total of 76 per cent in 1931), only one other plant developed symptoms during 1932. There has been a fair degree of success in preventing recurrence of witches' brooms on high-bush plants when it was possible to remove the diseased stems several inches below the area where symptoms appeared. It is not known how many cases of the recurrence of the disease in pruned plants were due to incompleteness of the eradication of the diseased tissue and how many to new infection.



FIG. 41. Witches' broom commonly affects blueberries in fields near woodlands and is more abundant close to the trees. This is due to the presence, in the woods, of an alternate host of the disease, namely, balsam fir. Stakes mark the location of affected blueberry plants. Note the dark, swollen stems of one at A. November 9, 1932.

Fungicidal Treatments. Plots treated with copper-lime dusts again gave the greatest increases in yield over that of untreated plots. Whereas, in 1931, the maximum difference in favor of

treatment was as much as 320 per cent, in 1932, in the same field, the greatest increase in yield on treated plots was only 70 to 80 per cent. Two applications of a commercial preparation, Oxo-Bordeaux, gave better results than five different strengths of home-mixed Bordeaux and than copper cyanamid all used with a fish oil adhesive. Sulfur and technical copper carbonate dusts gave unexpected increases in yield that may not have been due to their fungicidal properties.

Experiments indicate that thorough coverage of foliage with fungicides during or at the close of the blossoming period, when the leaves are still developing, is important in disease control. Later applications are beneficial but not nearly as satisfactory.

ANNOUNCEMENTS

NEW BUILDINGS

Cold Storage for Apples at Highmoor Farm. At the April meeting of the Board of Trustees of the University an appropriation was made for the construction of cold storage facilities for apples at Highmoor Farm. This plant is completed and in operation. It was constructed in the basement of the old barn. This basement was formerly used for pig pens and as a storage for machinery in disrepair, except for a small portion which was actually used as regular farm vegetable storage.

A part of the basement wall was of frame structure and it was necessary at the outset to construct permanent walls as a support for the barn. Some parts of the walls were of stone and these were faced with six inches of concrete. All frame structure was replaced with concrete so that at present the four walls are of concrete 12 inches in thickness or the equivalent, some portions being three feet of stone faced with six inches of concrete.

The walls, floor, and ceiling are insulated with four inches of corkboard laid in two courses of two inches each and all joints broken on the second course. The walls were first waterproofed and the corkboard was erected in hot asphalt and properly skewered or nailed. The walls and ceiling received a half-inch protective coat of cement plaster over the corkboard and the floor was given a three-inch concrete wearing floor.

The refrigerating equipment is a dry coil type with a refrigerating capacity at normal speed equivalent to eight tons of melting ice every 24 hours but can be forced to deliver the equivalent of 11 tons of melting ice. The load on the filled box was calculated by several engineers at around 6.5 to 7 tons, which leaves a fair margin for heavy demands on cooling during the picking season.



FIG. 42. A view of the interior of the storage showing the diffuser at the right. This diffuser has a capacity of 11,000 cubic feet of air per minute.

The refrigerating equipment is constructed, also, so that air can be used from the outside when temperatures are low enough to provide cooling for the box. With this arrangement the compressor need not be operated during a large part of the winter. This arrangement should effect a considerable saving in the cost of operation.

The box, completed, finished out approximately 73'x31'x7.5' or about 17,000 cubic feet. This space will accommodate around

10,000 boxes or 2,300 barrels provided they are packed in solidly. Allowing for spaces necessary for air circulation, the capacity for storage is somewhat less, probably about 7,200 boxes. It is estimated, however, that the space is adequate to care for the needs at Highmoor Farm for some years to come. Adequate storage facilities assure the proper handling of the crop by providing for the placing of the apples under the most favorable conditions on the very day they are picked.

Information on cost of construction and operation is being recorded in order that it may be available to those interested.

The Highmoor storage will be a great help in the research work, particularly with studies on the control of the apple fruit fly and on the keeping qualities of varieties picked at different dates or grown under varying soil conditions.

Greenhouse. The Board of Trustees also appropriated funds for the construction of a new greenhouse for the Station. The new house is built as a third section of the College of Agriculture range and is connected to it by a passage.

The house is approximately 110' x 32' and consists of three sections. The radiation installed permits the maintenance of a temperature of 50 to 55 degrees Fahrenheit in one section, 65 to 70 degrees in another, and 75 to 80 degrees in the third, these temperatures to be possible with the outside temperature 20 degrees below zero at night. This arrangement for three sections with different temperatures is of advantage because of the fact that various crop plants differ in their heat requirements from the standpoint of optimum growth.

The new greenhouse is a very valuable adjunct to the Station buildings and laboratories and supplies a long felt want. Much of the research work can be improved through the use of the greenhouse for various parts of the studies and other research work can be done almost twice as fast as is possible without such facilities.

COUNCIL AND STAFF CHANGES

The following additions were made to the Station Council: Mr. Charles C. Clements, effective March 3, 1932, as a representative of the Maine Poultry Improvement Association. Mr. A. L.

Deering, effective March 24, 1932, Director of the Extension Service.

- The changes in the Station Staff are as follows:

In Biology, Mr. Winfield S. Niles, laboratory assistant, completed his temporary appointment September 30, 1932.

In Home Economics, Miss Merna M. Monroe was appointed temporary assistant, effective September 1, 1932.

PROJECTS FOR 1932-1933

AGRICULTURAL ECONOMICS

An economic study of the dairy industry in Maine.

An economic study of the potato industry in Maine. (Cooperative with the Maine Development Commission).

Local market conditions and requirements of agricultural products in Maine (except Aroostook County).

BIOLOGY

The relation between shape and yield of apple trees.

Breeding new varieties of apples.

Nursery stock investigations in relation to bud selection in the apple.

Causes of cross and self sterility in certain plants, particularly the apple, through a cytologic and genetic study.

A study of the fertilizer requirements of the native Maine blueberry.

Breeding investigations with the blueberry.

Blueberry field management.

Fruitfulness in the blueberry.

Weed control in blueberry fields.

The mode of inheritance of milk production and associated characters in cattle.

Breeding investigations with garden crops.

Fertilizer experiments with potatoes in rotation with grain and clover.

A study of clover failures in a potato rotation.

A study of various green manuring crops as a means of increasing and maintaining the organic matter content of potato soils in two-, three-, and four-year rotations.

A study of the physiology of reproduction in poultry.

Influence of anti-rachitic substances on growth in poultry.

Fertilizer experiments with sweet corn and beans in a four-year rotation—oats, clover, sweet corn, and beans and with sweet corn in a two-year rotation—sweet corn and an annual green manuring crop (mixture of oats and peas).

Inheritance of certain characters in relation to yield and quality in sweet corn and beans.

Cytological studies in species crosses.

Small grain variety test including oats, barley, and wheat.

Breeding investigation with small fruits, particularly raspberries and strawberries.

CHEMISTRY

INSPECTION

Inspection of feeding stuffs.

Inspection of fertilizers.

Inspection of foods and drugs.

Inspection of fungicides and insecticides.

Inspection of seeds.

Inspection of gasolines and oils.

Calibration of creamery glassware.

Inspection of milk and cream.

Miscellaneous analyses.

INVESTIGATION

Chemical composition of cows' milk in parents and hybrid offspring.

(In cooperation with the Biology Department).

Inheritance and physiology of the secretion of milk solids.

(In cooperation with the Biology Department).

Chemical analyses in connection with the problem of nutrition and growth of poultry and dairy cattle. (In cooperation with the Biology Department.)

Soil acidity investigation and analysis of materials used in connection with the permanent rotation and fertility experiments at Aroostook Farm.

(In cooperation with the Biology Department.)

A comparison of copper fungicides as to the adherence of the copper contents to potato foliage in spraying and dusting. (In cooperation with the Plant Pathology Department.)

Miscellaneous analyses.

ENTOMOLOGY

Aphid investigations with special reference to the different food plants of migratory species.

A study of apple maggot problems including dispersal.

Insects affecting the blueberry.

Control of the cabbage maggot.

Experiments with sodium and calcium fluosilicates in the control of the cucumber beetle and other insects.

Cutworms affecting field and garden crops.

Insects in relation to the transmission of virus diseases of potatoes.

Garden slug control.

Wireworms affecting field and garden crops.

A study of the life history and control of the Mexican bean beetle in Maine.

HOME ECONOMICS

The economic utilization of electricity in food preparation in Maine rural homes.

The factors affecting the cooking quality of potatoes.

PLANT PATHOLOGY

Apple scab control.

Blueberry diseases.

Cucurbit disease control.

Differentiation and dissemination of potato virus diseases.

Dusting and spraying potatoes.

Economic effects and control of potato virus diseases.

Histology and ecology of potato tuber rots.

Identification and dissemination of causes of potato rots.

Seed disinfection of potatoes.

Stem-end browning of potato tubers.

Plant disease survey and miscellaneous diseases. Annual recording, through correspondence and observations, of the prevalence and severity of plant diseases, and preliminary experiments on miscellaneous diseases that develop importance.

PUBLICATIONS

The Station is organized so that the work of investigation is distinct from the work of inspection. The results of investigation are published in the bulletins of the Station and in scientific journals, both foreign and domestic. The bulletins for the year make up the annual report. The results of the work of inspection are printed in publications known as Official Inspections. These are paged independently of the bulletins and are bound with the annual report as an appendix thereto. Miscellaneous publications consisting of newspaper notices of bulletins, newspaper bulletins and circulars which are not paged consecutively and for the most part are not included in the annual report, are issued during the year.

BULLETINS ISSUED IN 1932

- No. 361. Costs and Returns in Producing Milk, Raising Heifers, and Keeping Herd Bulls in Maine. 175 pages.
- No. 362. Potato Spraying and Dusting Experiments 1929 to 1931. 57 pages.
- No. 363. Progress of Investigations, Abstracts of Papers not Included in Bulletins, Finances, Meteorology. 76 pages.

OFFICIAL INSPECTIONS ISSUED IN 1932

- No. 143. Foods and Drugs. 16 pages.
- No. 144. Commercial Feeding Stuffs, 1931-1932. 48 pages.
- No. 145. Commercial Fertilizers, 1932. 32 pages.
- No. 146. Commercial Agricultural Seeds, 1932. Fungicides and Insecticides, 1932.

ABSTRACTS OF PAPERS PUBLISHED BY THE
STATION IN 1932 BUT NOT INCLUDED
IN THE BULLETINS

A complete list of all the Bulletins issued by and from the Station in 1932 is given on page 300 of this Report. The following pages contain abstracts of the papers published during the year and not included in the Bulletins or Official Inspections.

DISPERSAL OF THE APPLE MAGGOT*

This paper presents the results obtained and the technique developed in a study of apple maggot dispersal. It clearly indicates the influence of the neglected apple tree in connection with the control of this important pest in commercial plantings situated near uncared for apple trees.

During the course of the experiment a total of 1,035 flies were marked and liberated at one release point. Of this number 123 individuals were subsequently recovered at distances varying from 38 to 156 yards from the liberation point.

* This is an abstract of a paper by C. R. Phipps and C. O. Dirks, having the same title and published in the Journal of Economic Entomology 25:576-582. 1932.

As a result of this study it was concluded that neglected apple or wild haw trees located within 200 yards of commercial orchards should be sprayed regularly or cut down.

SPRAYING AND DUSTING EXPERIMENTS FOR THE CONTROL OF POTATO APHIDS*

Mechanical factors influence to a relatively slight degree the efficiency of materials toxic to the potato aphids *Macrosiphum gei* and *Myzus persicae*. Differences in the distribution of the materials due to mechanical factors seem to be the most important of any such considerations. That these differences are important is shown by a study of the distribution of the aphid population of representative plants before and after treatment. A limiting factor in the increase of aphids on Long Island is found in certain fungus diseases. The incidence of these diseases appears to be influenced by present spray practices. Dusting for aphids if the weather be favorable, is shown to be as efficient a method as any tested.

THE APPLE MAGGOT†

This paper is in the nature of a report on the Station apple maggot investigations in 1931. The results of that season's dispersal studies are presented and furnish a basis for the recommendation of neglected apple tree removal within a radius of 200 yards of commercial orchards.

The problem of control is considered from the following angles:

1. Control in orchards which are isolated.
 - a. Orchards with early and late varieties.
 - b. Orchards containing only fall and winter varieties.
2. Control in orchards subject to infestation from neighboring trees.

* This is an abstract of a paper by G. W. Simpson, having the same title and published in the Journal of Economic Entomology 25:634-639, 1932.

† This is an abstract of a paper by C. R. Phipps, having the same title and published in Report of Maine State Pomological Society for 1931, pp. 13-20, 1932.

In general in well-isolated orchards containing only fall and winter varieties this insect should be readily controlled by one or two thorough and timely spray applications. If both early and late varieties are in the same planting the drops from the early apples should be picked up and destroyed every two or three days.

Where dispersal is a factor the neglected trees should be treated or removed in addition to the program of spraying and drop collection.

In connection with the life history studies it is shown that larvae which develop from early apples tend to emerge as flies somewhat earlier than those developed in late varieties. There is also a considerable difference in time of fly emergence in different localities. It therefore appears highly desirable to obtain emergence records in various apple-growing districts in order that growers may time their spray applications accurately.

THE RELATION OF MATURITY, SIZE, PERIOD IN STORAGE, AND VARIETY TO THE SPEED AND EVENNESS OF COOKING OF POTATOES*

By the use of a standardized technic and a penetrometer it is possible to compare potatoes in speed and evenness of cooking. Tests on a series of Green Mountain tubers harvested at different dates showed that the immature potatoes, those dug at the earlier dates, cooked more evenly than those dug at later dates. Bud ends always cooked more quickly than stem ends but this difference was least with the most immature tubers. The difference between bud and stem ends decreased during three months' storage. Thus potatoes cook more evenly during the winter than immediately after digging in the fall.

In this series, the stem ends of tubers of extremely small and extremely large sizes from the same lot showed no conspicuous difference in speed of cooking. However, in the last dug or most mature lot, the larger tubers gave bud end slices which cooked more

* This is an abstract of a paper by Mabel C. Lancaster and Marion Deyoe Sweetman having the same title and published in the Jour. Home Econ. 24:262-268. 1932.

quickly than those from the smaller; but the difference may have been in part due to their greater tendency to break up.

In a comparative study of Spaulding Rose, Bliss Triumph, Irish Cobbler, Green Mountain and Idaho Russet varieties, the difference between bud and stem end was greatest in the Green Mountain and Idaho Russet. A practical application is indicated when potatoes break up extensively during boiling; tubers should be divided crosswise and the two halves cooked separately. Then stem ends may be cooked sufficiently without overcooking bud ends.

ESTIMATED YIELD LOSSES FROM LATE BLIGHT IN AROOSTOOK COUNTY FOR 1930 AND 1931*

A survey of Aroostook County Green Mountain fields in late August showed 65 per cent, of 671 fields, dead in 1930 and 34 per cent, of 940 fields, dead in 1931, because of late blight. Experimental plots gave evidence of a yield loss of about 20 per cent in such fields. Of the total possible yield of Green Mountains in 1931, the loss then would be about seven per cent.

A PROMISING BLIGHT RESISTANT POTATO†

A variety bearing different names including "Foster's Rust Proof" was much more resistant to late blight (*Phytophthora infestans*) than Green Mountains in the field, even when inoculated artificially, but not in moist chambers or in case the disease had entered the leaf. The tubers were resistant to attack by late blight and consequent bacterial decay. The yield rate of the Rust Proof was about the same as for Green Mountains on well-drained soil in spite of a longer season by three weeks, and about 20 per cent less where living several days longer. Cooking quality was similar in the two varieties. Rust Proof has shallow eyes and a smooth, white, tough, firm skin, and keeps well in storage. The advantage

* This is an abstract of a paper by Reiner Bonde, having the same title and published in the Plant Disease Reporter 16:14-15. 1932.

† This is an abstract of a paper by Reiner Bonde, having the same title and published in the American Potato Journal 9:49-54. 1932.

that might be gained from a blight-resistant variety is indicated by surveys which showed 35 to 65 per cent of the fields dead in late August with consequent yield loss in such fields of about 20 per cent, judging from experimental plots.

POTATO VIRUS DISEASES IN 1931*

One kind of mosaic is found in apparently healthy plants of all American potato varieties but not naturally in potato seedlings. Symptoms of mosaic are masked in some varieties, more than was suspected a few years ago. Spindle tuber is transmitted by grass-hoppers, flea beetles, tarnished plant bugs, Colorado potato beetles, contact of seed pieces, seed-cutting knives, and picker planters, but not by soil. Attempts have failed to develop practical methods of detecting mosaic, spindle tuber, and leafroll in the dormant tuber following recent infection. Leafroll is transmitted differently in amount by different species of plant-lice. Mild mosaic reduced the yield about 20 per cent. In New Jersey, leafroll is probably most serious and rugose mosaic is probably more serious than mild mosaic. In Michigan, the best control was secured with single-tuber lines or clon stocks, but even with this method it was difficult to keep out disease. Uncertified potatoes in Canada can not legally be advertised or sold as seed. There, foundation stock is defined as that showing no more than 0.3 of one per cent virus diseases.

METEOROLOGICAL OBSERVATIONS

For many years the meteorological records were made at the Experiment Station by members of the Station staff. This work was transferred to the Department of Physics of the University of Maine on June 1, 1911. The Station is indebted to the Department of Physics for the meteorological summary for 1932 which appears on the following page.

* This is an abstract of a literature review by Donald Folsom, having the same title and published in the Amer. Potato Jour. 9:173-181. 1932. Only the reliable and new data of most interest to Maine potato growers are given here.

METEOROLOGICAL SUMMARY FOR 1932

1932

BULLETIN 363—REPORT OF PROGRESS

305

	January	February	March	April	May	June	July	August	September	October	November	December	Average	Total
Highest temperature	65	52	56	75	98	90	89	92	88	80	66	63	/	/
Lowest temperature	-4	-10	7	22	31	37	45	48	33	27	1	-13	/	/
Mean temperature	25.58	16.95	28.22	47.00	55.70	63.22	66.65	69.71	60.11	51.88	35.38	28.14	45.71	/
Mean temperature in 64 years	16.35	18.96	30.18	39.22	50.66	61.24	67.14	65.76	59.18	49.32	37.52	23.14	43.30	/
Total precipitation in inches	4.24	1.97	2.07	3.24	3.28	1.53	4.62	5.21	5.58	5.68	2.99	2.19	42.60	/
Mean total precipitation in 64 years	3.88	3.43	3.70	2.81	3.33	3.36	3.44	3.47	3.48	3.96	3.54	3.55	41.95	/
Number of days with .01 inch precipitation or more	12	9	9	7	9	7	12	7	10	8	8	8	106	/
Snowfall in inches	11.0	13.3	11.0	—	—	—	—	—	—	—	0.5	6.3	42.0	/
Mean snowfall in 64 years	21.4	21.3	14.1	5.6	—	—	—	—	—	—	0.73	6.0	15.7	84.8
Number of clear days	14	17	18	14	20	16	19	18	15	14	17	10	192	/
Number of partly cloudy days	7	3	5	8	5	11	3	7	7	9	5	15	85	/
Number of cloudy days	10	9	8	8	6	3	9	6	8	8	8	6	89	/
Average wind velocity in miles per hour	5.01	5.15	6.18	6.29	4.17	4.08	3.94	3.62	4.85	5.94	5.34	3.86	4.80	/

The instruments used are located on the University campus at Lat. $44^{\circ} 54' 2''$ N., Long. $64^{\circ} 40' 5''$ W. Elevation 135 feet. They are the same as those used in preceding years and include: maximum and minimum thermometers, rain gauge, self-recording anemometer, vane, and barometers. The observations at Orono now form an almost unbroken record of sixty-four years.

REPORT OF THE TREASURER

The Station is a department of the University and its accounts are kept in the office of the Treasurer of the University. The books, voucher files, etc., are, however, all distinct from those of the other departments of the University. The classification of accounts is that prescribed by the auditors on the part of the Federal Government, and approved by the State Auditor. All of the accounts are audited by the State Auditor, and the Hatch Fund, Adams Fund, and Purnell Fund Accounts are also audited by the Office of Experiment Stations acting for the United States Secretary of Agriculture in accordance with federal law.

The income of the Station from federal and state appropriations for the year that ended June 30, 1932, was:

U. S. Government, Hatch Fund.....	\$15,000.00
U. S. Government, Adams Fund.....	15,000.00
U. S. Government, Purnell Fund.....	60,000.00
State of Maine, Mill Tax.....	35,000.00
State Department of Agriculture.....	13,102.32
Other Income, Sales, etc.....	10,419.30
<hr/>	
Total Income.....	\$148,521.62

The cost of maintaining the laboratories for the inspection analyses is borne by analysis fees and by the State Department of Agriculture. The income from sales at the experimental farms and the poultry plant is used for the expense of investigations. The cost of printing Station bulletins is paid for by the University in addition to the funds mentioned above.

At Aroostook Farm there are in connection with the cooperative work with the Federal Department of Agriculture certain expenditures for the Department made from sales of crops from Department investigations that do not appear in the tabular statements. They are carried as distinct and separate accounts, always with credit balances on the Station ledger.

REPORT OF THE TREASURER FOR THE YEAR ENDING JUNE 30, 1932
DISBURSEMENTS

	Federal Funds			State Funds		Other Income, Sales, etc.	Total
Hatch	Adams	Purnell	Mill Tax	Inspections			
Salaries -----	\$ 9,398.00	\$15,000.00	\$48,463.04	\$10,141.34	\$10,243.46	\$1,121.12	\$80,249.96
Labor -----	2,842.06	-----	3,564.99	11,494.33	1,265.90	3,675.11	22,782.49
Stationery and Office Supplies -----	33.59	-----	247.43	368.58	24.30	13.47	687.37
Scientific Supplies -----	22.13	-----	918.79	165.61	378.04	33.18	1,617.75
Feeding Stuffs -----	422.90	-----	1,706.34	1,365.09	-----	58.96	3,143.98
Sundry Supplies -----	184.85	-----	832.32	2,047.37	90.05	281.08	3,435.67
Fertilizers -----	-----	-----	20.15	1,380.57	-----	-----	1,401.02
Communication Service -----	148.96	-----	71.28	231.24	51.75	57.06	560.29
Travel Expenses -----	527.29	-----	4,554.30	1,001.67	28.48	906.89	7,018.68
Transportation of Things -----	18.86	-----	197.71	721.21	161.99	77.20	1,176.97
Publications -----	-----	-----	19.68	70.82	-----	18.94	109.39
Heat, Light, Water and Power -----	1,381.82	-----	558.96	1,753.96	571.29	510.21	4,775.64
Furniture, Furnishings and Fixtures -----	1.36	-----	228.91	131.33	19.07	177.36	558.63
Library -----	106.25	-----	97.01	1,173.23	13.00	88.15	1,477.64
Scientific Equipment -----	1.93	-----	1,516.38	774.60	282.73	293.57	2,868.70
Live Stock -----	-----	-----	43.50	40.50	-----	-----	84.00
Tools, Machinery and Appliances -----	-----	-----	1,135.97	1,321.65	.62	895.43	3,353.67
Buildings and Land -----	-----	-----	330.39	418.43	11.64	325.45	1,075.91
Contingent -----	-----	-----	530.50	407.98	20.00	45.85	1,004.33
Total -----	\$15,000.00	\$15,000.00	\$60,000.00	\$35,000.00	\$13,102.32	\$5,579.02	\$146,681.34

